MANAGED AQUIFER RECHARGE FOR SUSTAINABLE GROUND WATER

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OBJECTIVES

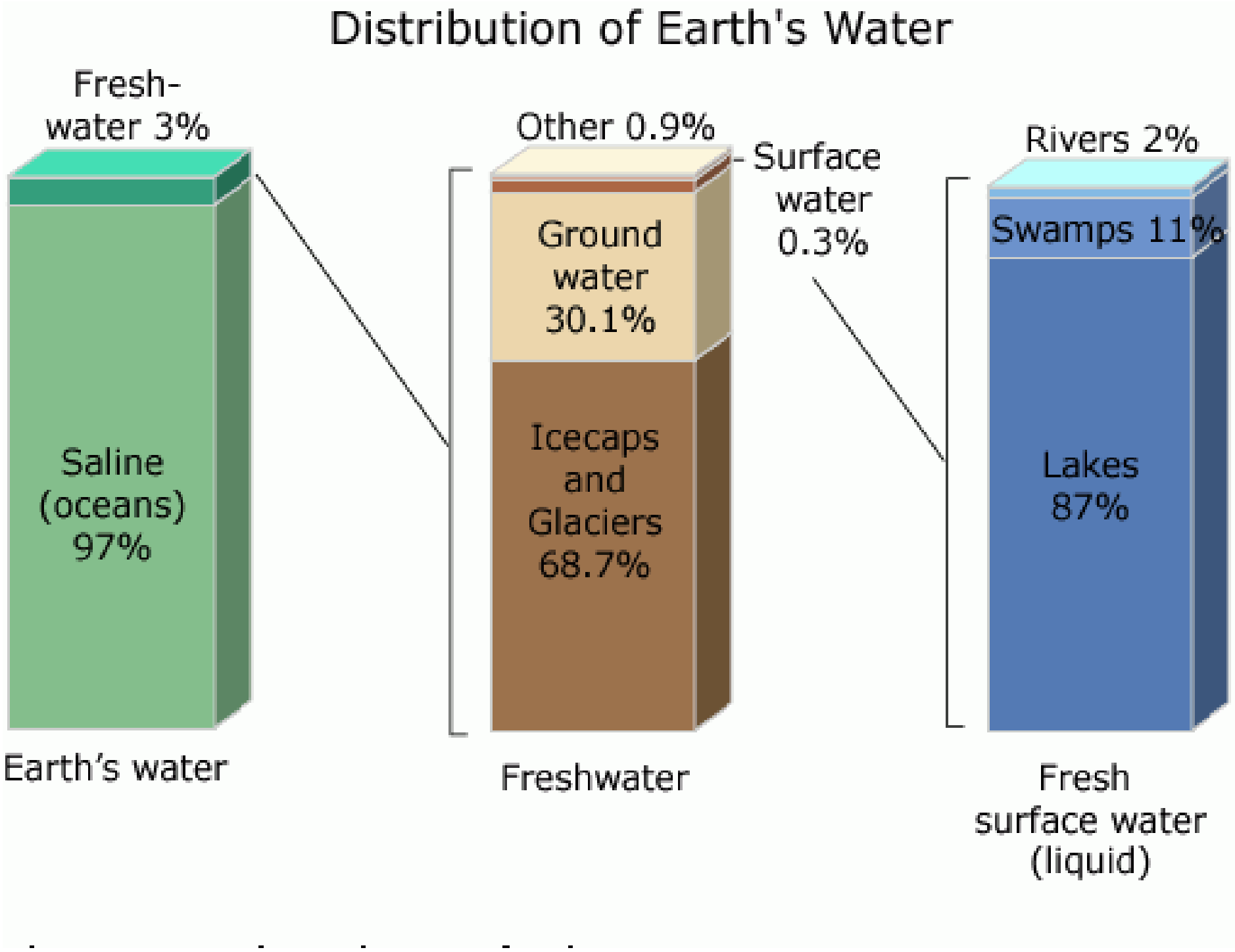
- To enable Office Trainees to understand the concept and scope of managed aquifer recharge and practice it in the field.

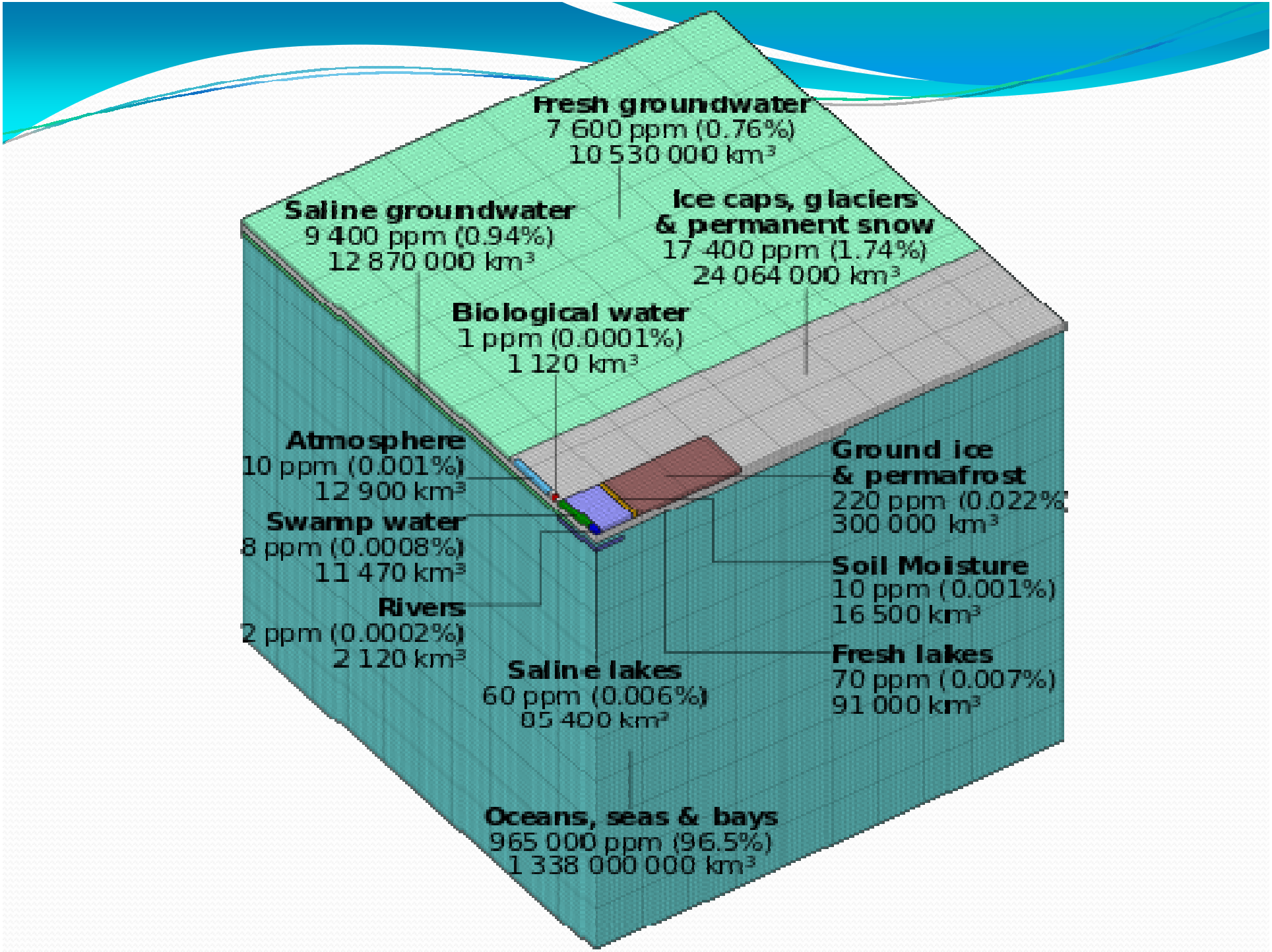
RECHARGE

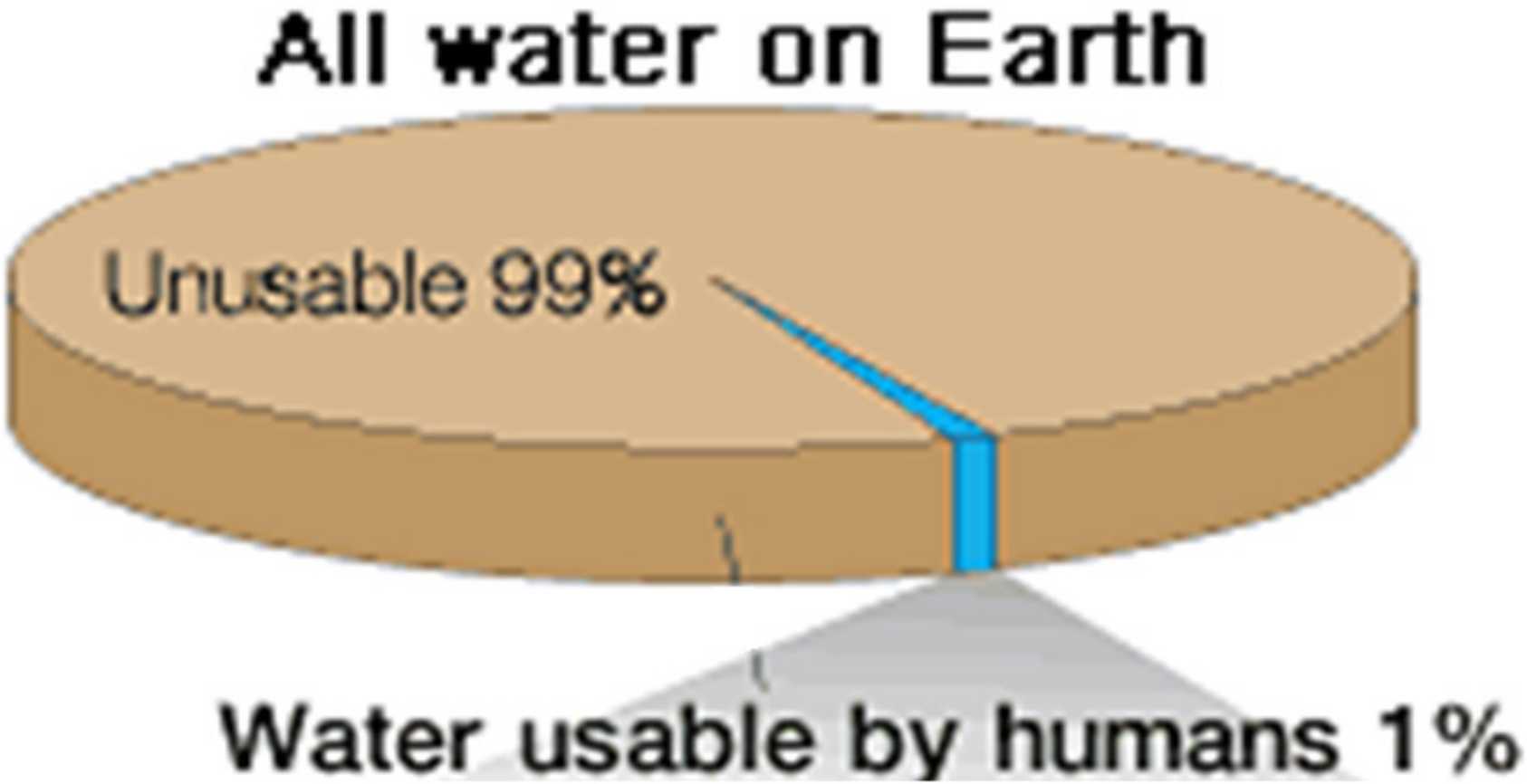
The processes by which ground water is absorbed into the zone of saturation.

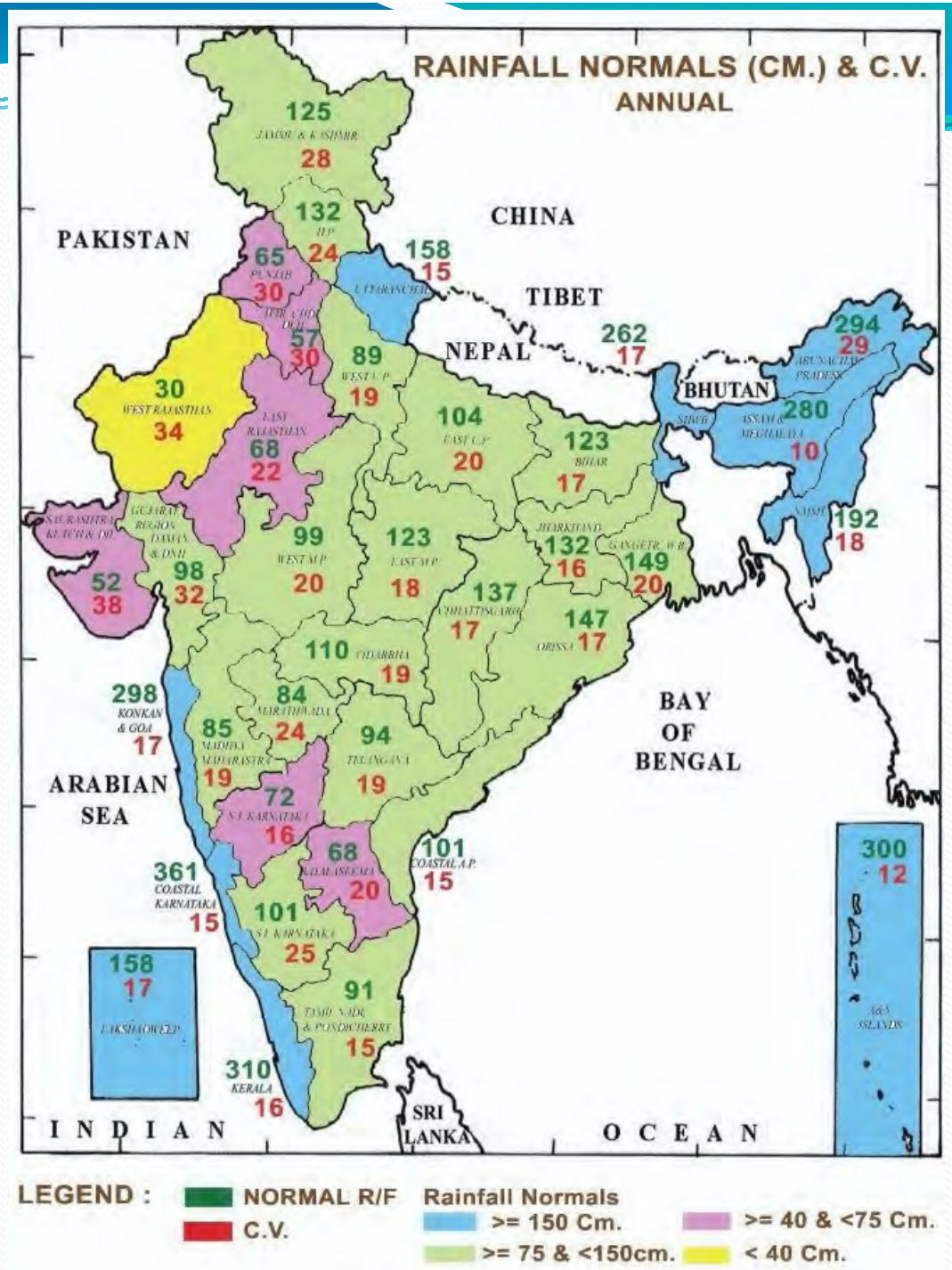
SUSTAINABLE

- Capable of being continued with minimal long-term effect on the environment.
  - sustainable ground water
  - sustainable agriculture.


Distribution of Earth's Water
Fresh-
water 3%
Saline
(oceans)
97%
Earth's water
Other 0.9%
Ground
water
30.1%
Icecaps
and
Glaciers
68.7%
Freshwater
Surface
water
0.3%
Rivers 2%
Swamps 11%
Lakes
87%
Fresh
surface water
(liquid)


Fresh groundwater
7 600 ppm (0.76%)
10 530 000 km³
Saline groundwater
9 400 ppm (0.94%)
12 870 000 km³
Ice caps, glaciers
& permanent snow
17 400 ppm (1.74%)
24 064 000 km³
Biological water
1 ppm (0.0001%)
1 120 km³
Atmosphere
10 ppm (0.001%)
12 900 km³
Swamp water
8 ppm (0.0008%)
11 470 km³
Rivers
2 ppm (0.0002%)
2 120 km³
Saline lakes
60 ppm (0.006%)
85 400 km³
Ground ice
& permafrost
220 ppm (0.022%)
300 000 km³
Soil Moisture
10 ppm (0.001%)
16 500 km³
Fresh lakes
70 ppm (0.007%)
91 000 km³
Oceans, seas & bays
965 000 ppm (96.5%)
1 338 000 000 km³


All water on Earth
Unusable 99%
Water usable by humans 1%

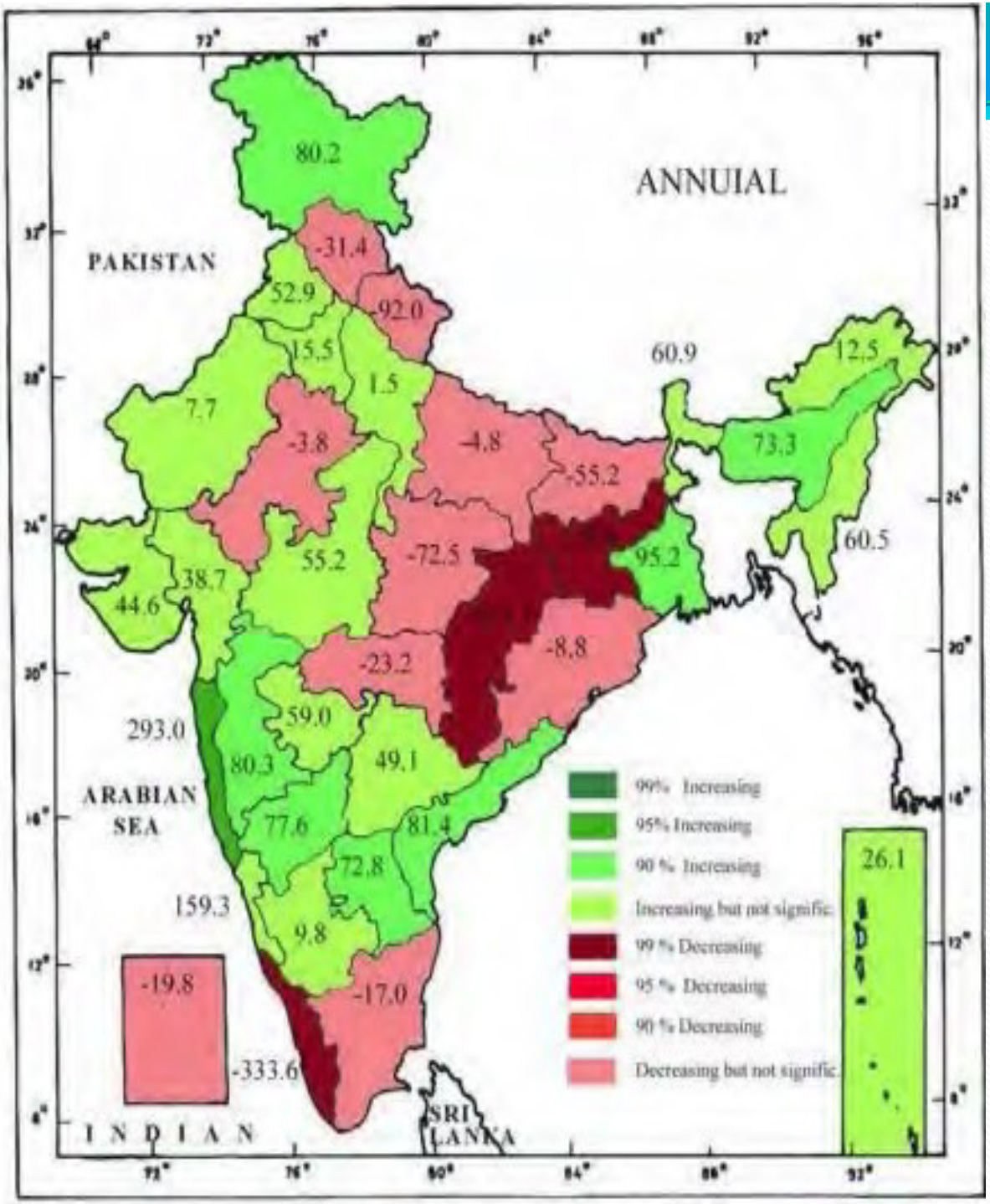


LEGEND : NORMAL R/F, C.V.

Rainfall Normals: >= 150 Cm.; >= 75 & <150cm.; >= 40 & <75 Cm.; < 40 Cm.

[Source: IMD]

RAINFALL TREND

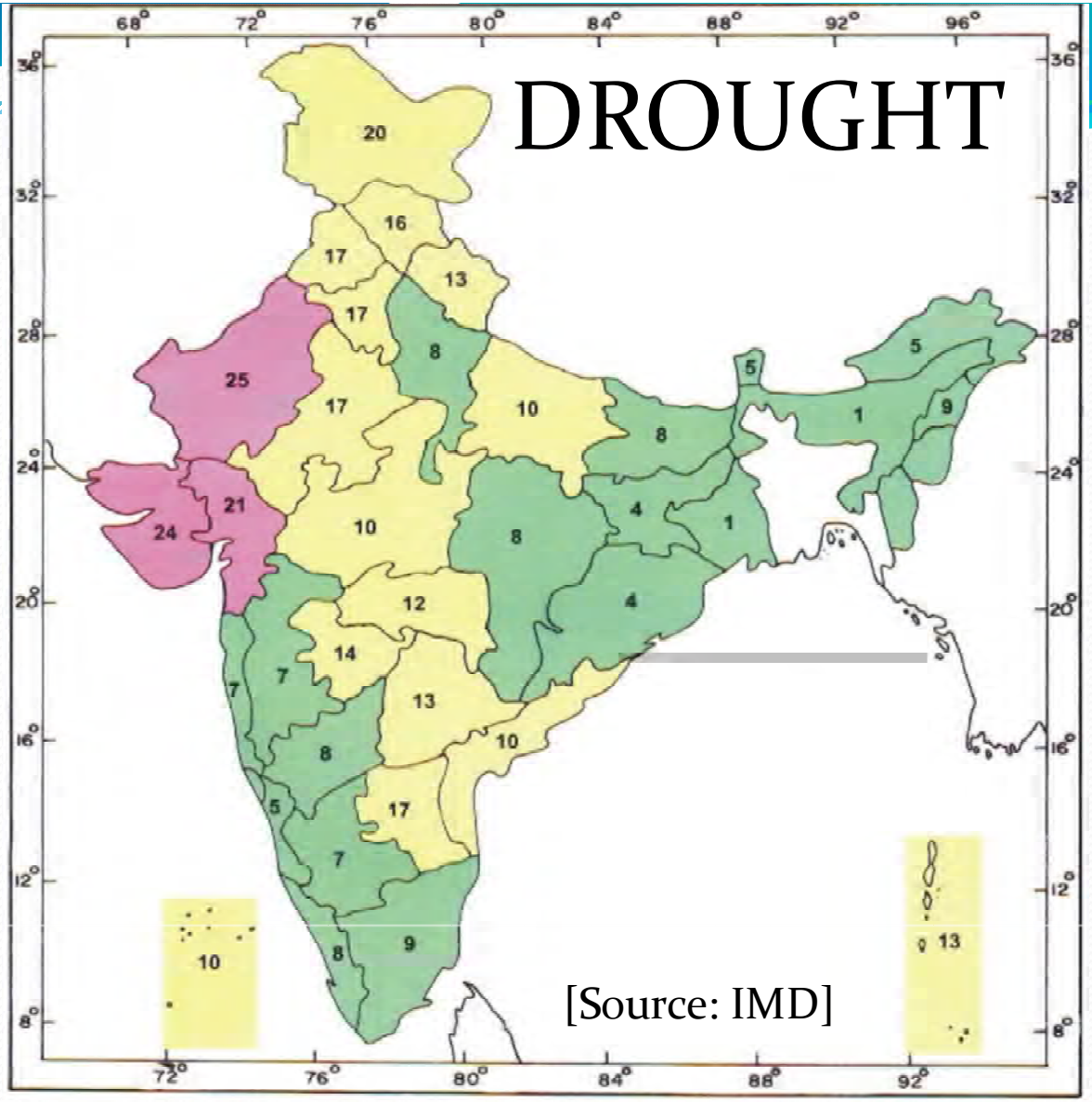


[Source: IMD]

OCCURRENCE

DROUGHT

PROBABILITY



CRONICALLY DROUGHT PRONE AREA
(PROBABLITY OF OCCURRENCE OF DROUGHT MORE THAN 20%)

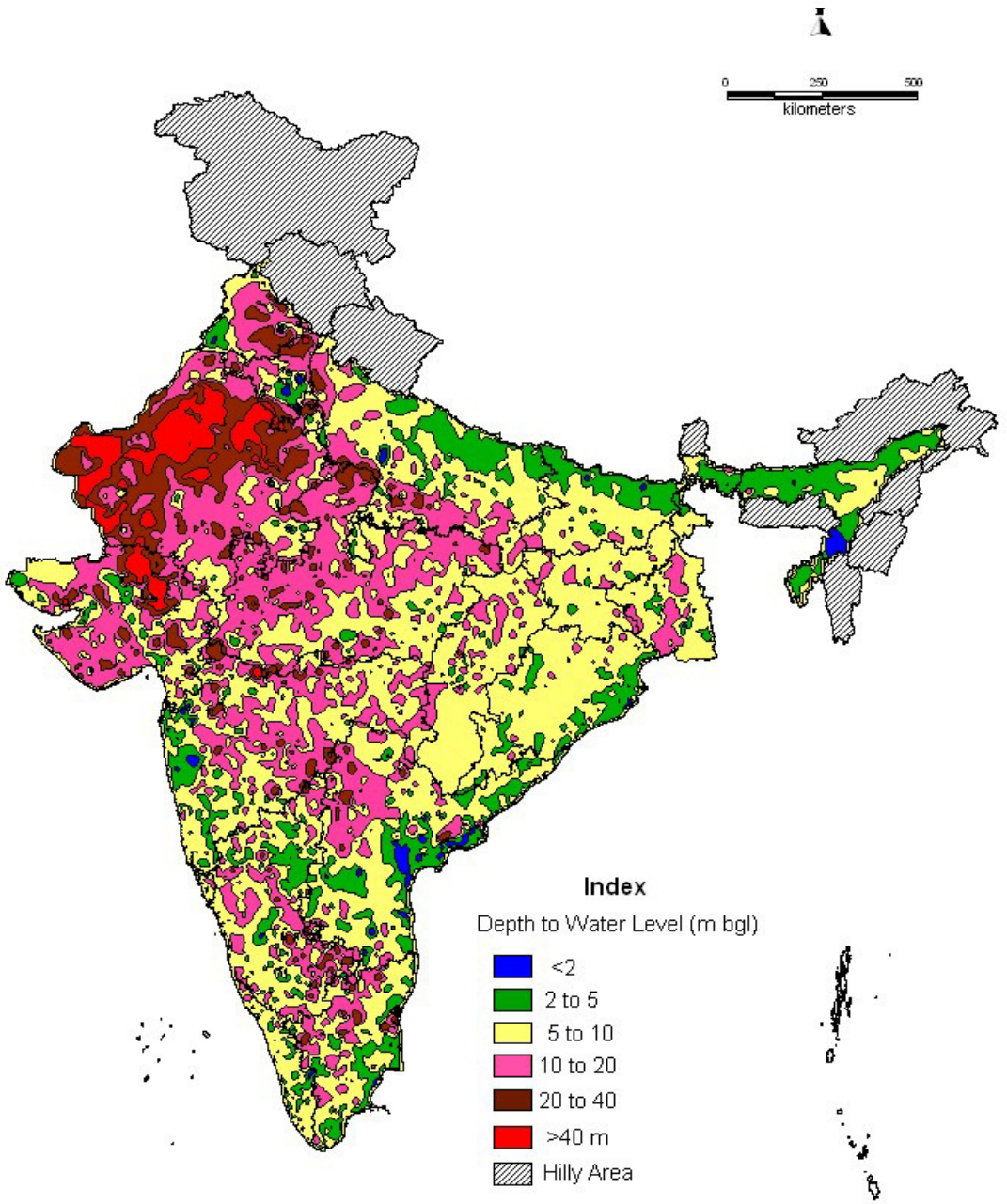
FREQUENTLY DROUGHT PRONE AREA
(PROBABILITY OF OCCURRENCE OF DROUGHT 10% TO 20%)

LEAST DROUGHT PRONE AREA
(PROBABILITY OF OCCURRENCE OF DROUGHT LESS THAN 10%)

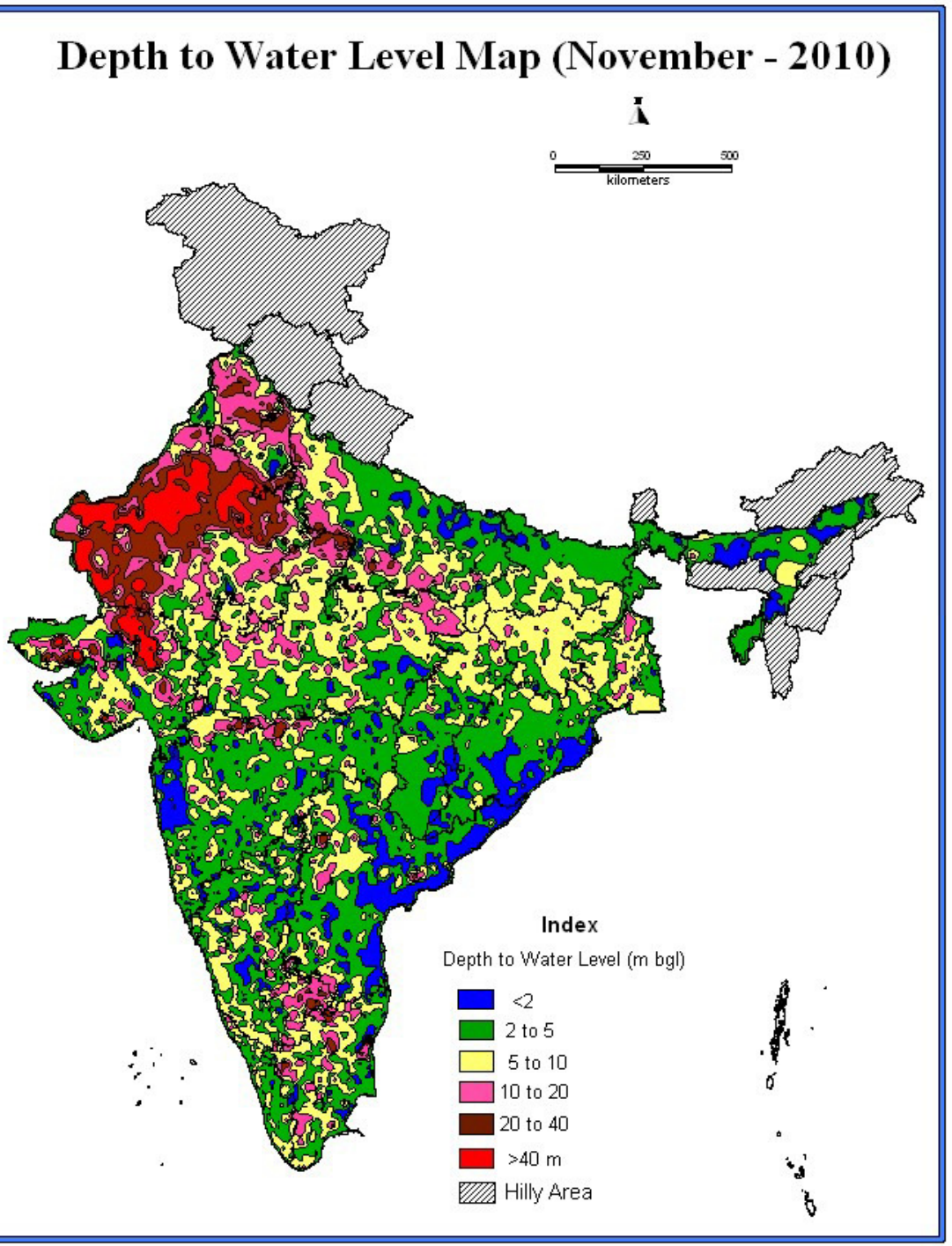
INDIA'S WATER RESOURCES

- Total Precipitation: 4000 BCM
- Total Surface Water: 1869 BCM
- Total Utilizable : 1121 BCM
  - Surface Water - 690 BCM
  - Ground Water - 431 BCM (38.45%)

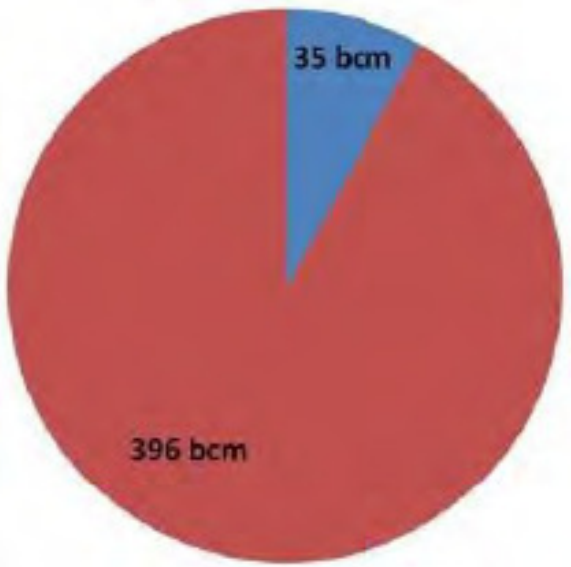
Depth to Water Level Map (May - 2010)



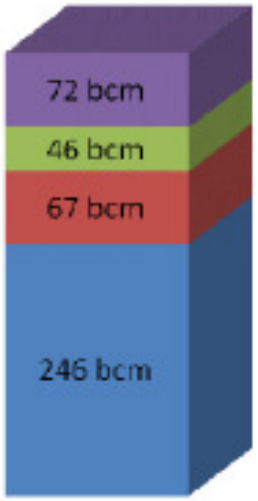
Depth to Water Level Map (November - 2010)



Ground Water Resources of India (CGWB)

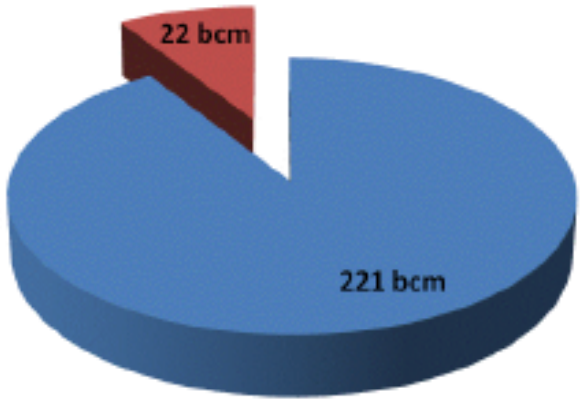


- Provision for Natural Discharge during non-monsoon season
- Net Annual Ground Water Availability



- Recharge from other sources (non-monsoon season)
- Recharge from rainfall (non-monsoon season)
- Recharge from other sources (monsoon season)
- Recharge from rainfall (monsoon season)

Annual Replenishable Ground Water Resources (431 bcm)



- Irrigation Draft
- Domestic & Industrial draft

Annual Ground Water Draft (243 bcm)

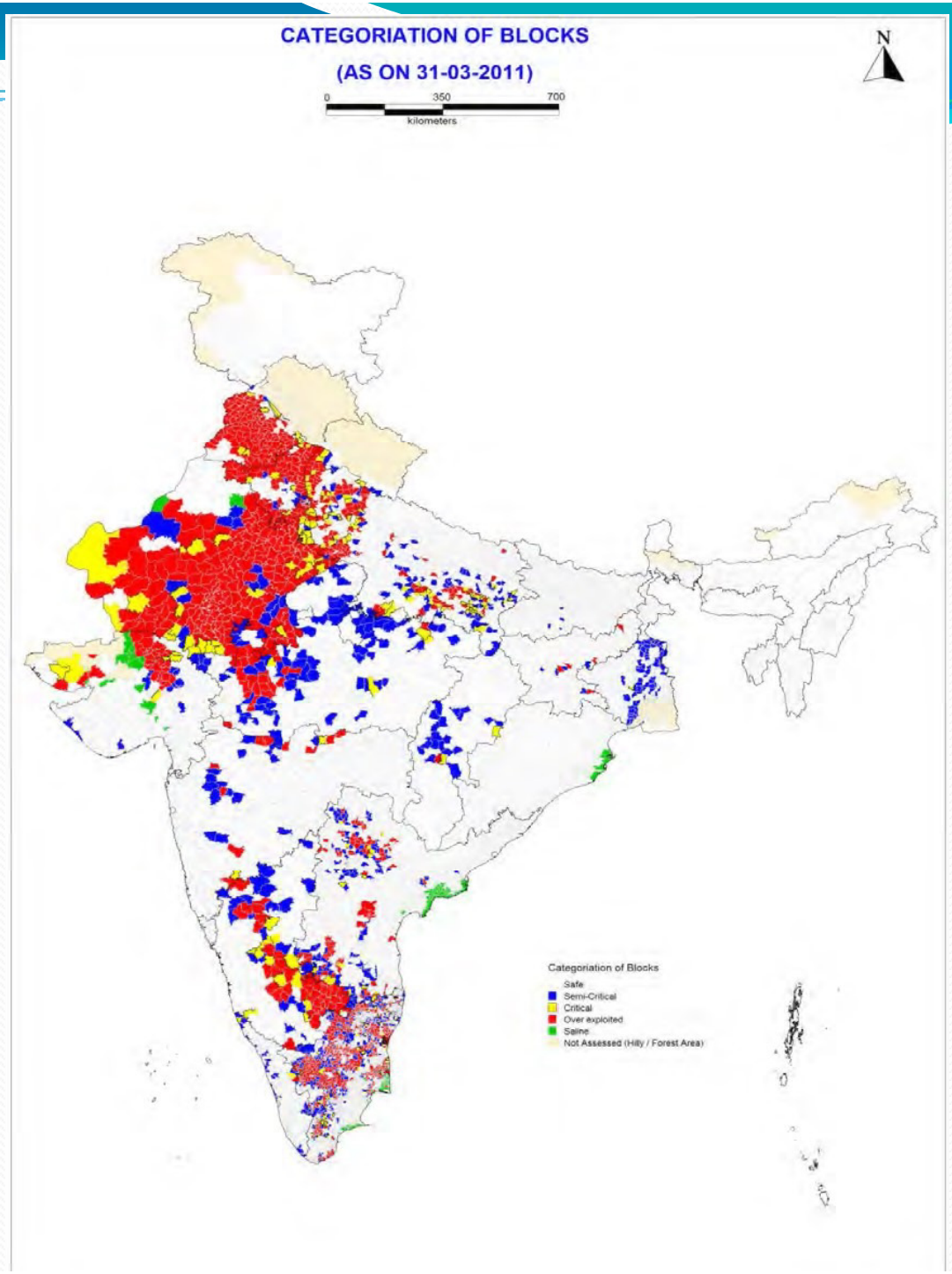
STAGES OF GW DEVELOPMENT

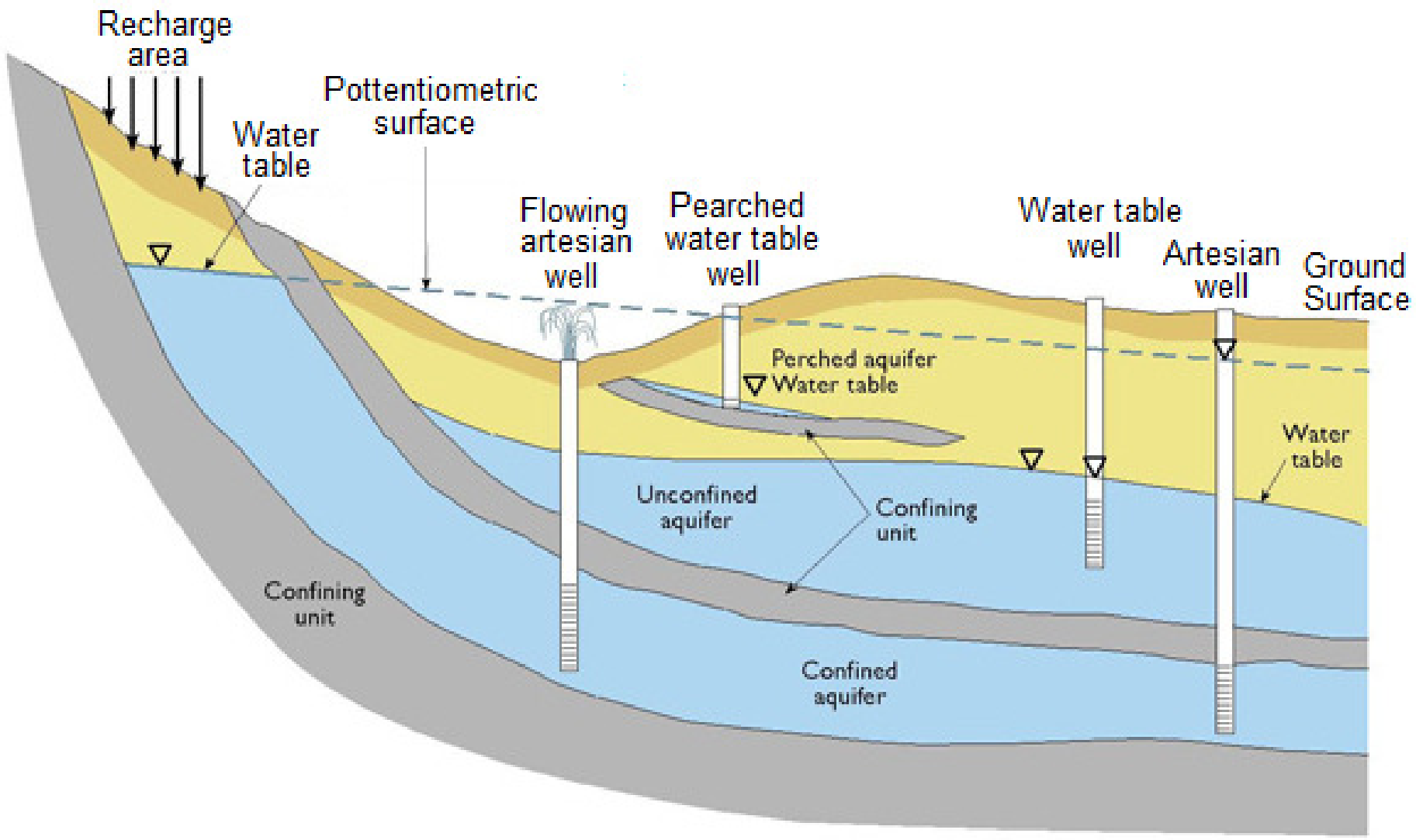
YEAR	% DEVELOPMENT
1991	32
1998	37
2004	58
2009	61
2011	62

- Out of 5845 assessment units, 1071 units are overexploited.

GROUND WATER CONTRIBUTION

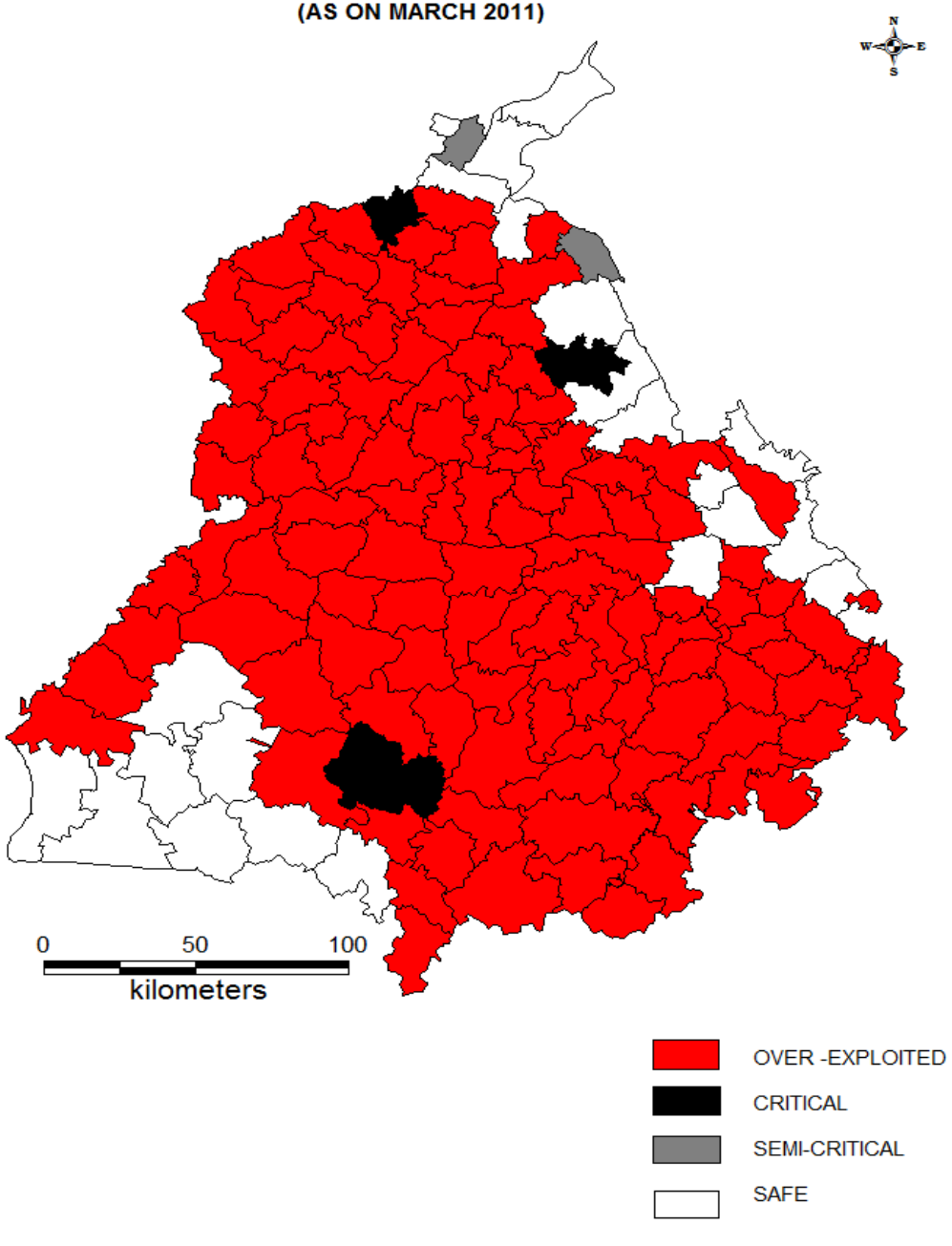
- 80% - Rural domestic water supply
- 50% - Urban & Industrial water supply
- 62% - Irrigation water supply
  - 29% (1951)
  - 38% (1971)
  - 51% (1991)
  - 62% (2003): an increase of 5 times in area irrigated since 1951 (39 Million Ha).
    (China 19 M ha, USA 17 M ha)


CATEGORIATION OF BLOCKS
(AS ON 31-03-2011)
0
350
700
kilometers
N
Categoriation of Blocks
Safe
Semi-Critical
Critical
Over exploited
Saline
Not Assessed (Hilly / Forest Area)

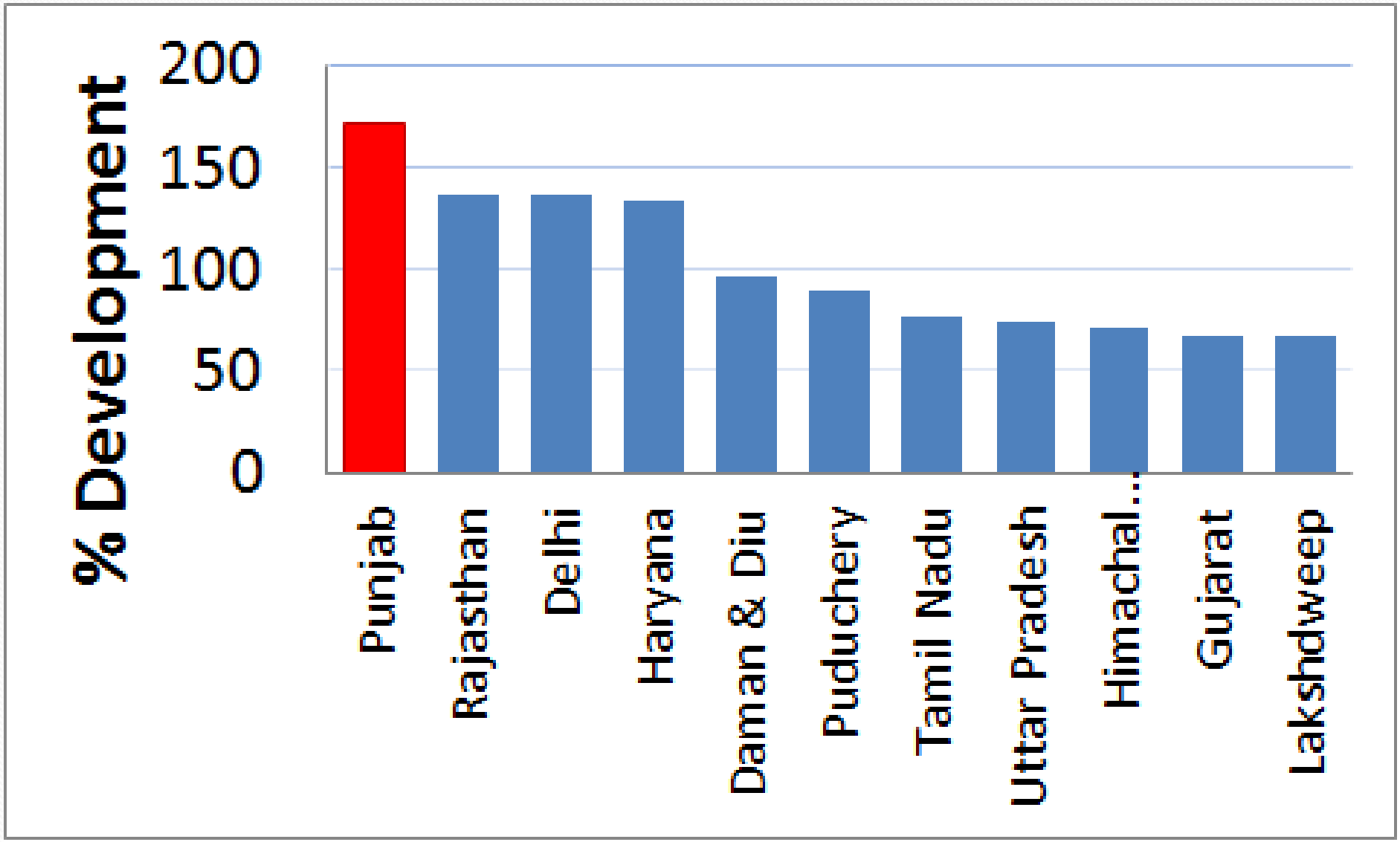

Recharge area
Water table
Pottentiometric surface
Flowing artesian well
Pearched water table well
Water table well
Artesian well
Ground Surface
Perched aquifer
Water table
Water table
Unconfined aquifer
Confining unit
Confining unit
Confined aquifer

CATEGORISATION OF GROUND WATER ASSESSMENT UNITS

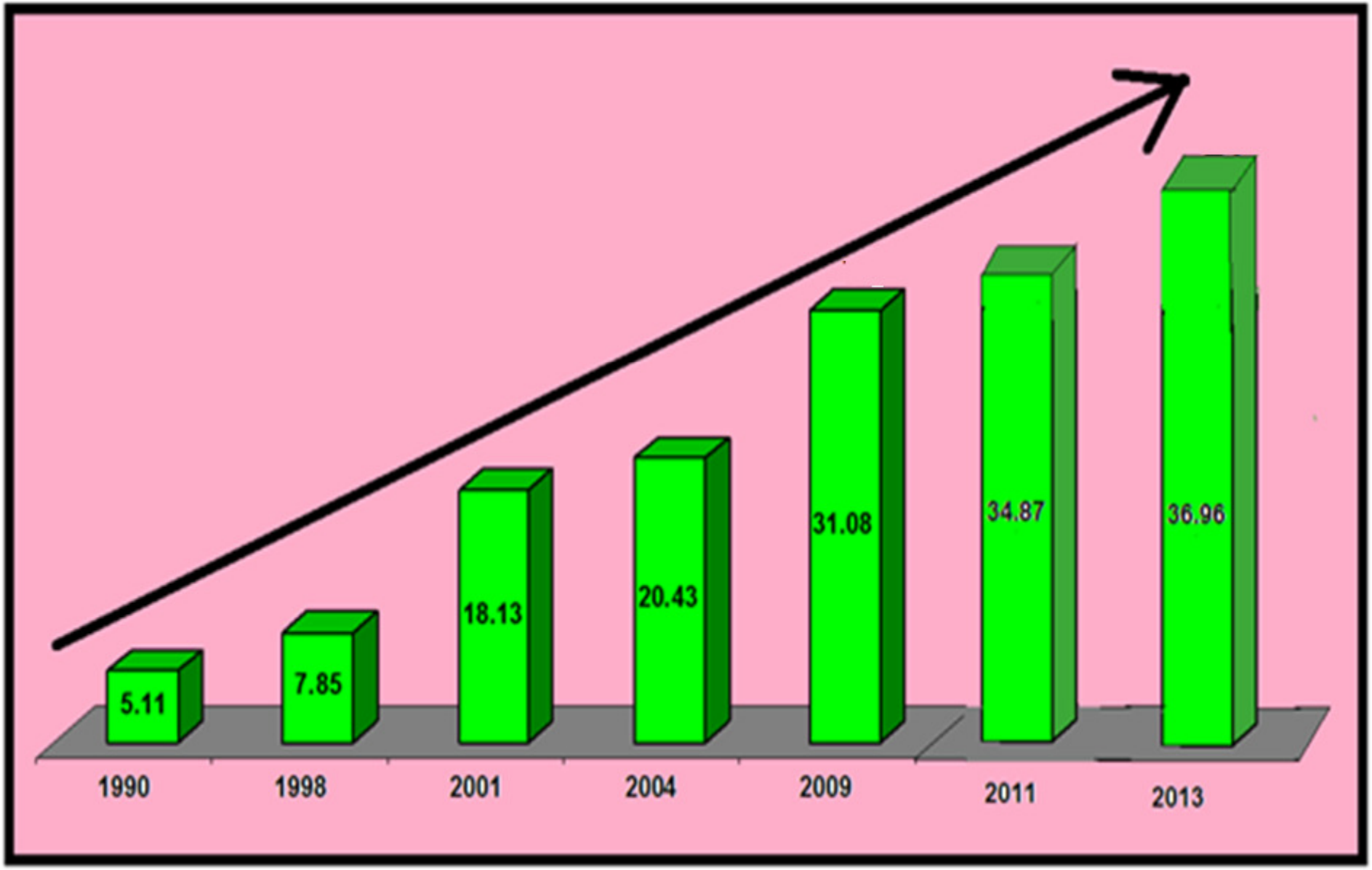
(AS ON MARCH 2011)



STAGE OF GW DEVELOPMENT



GROUND WATER DEVELOPMENT IN CHHATTISGARH as on 2013

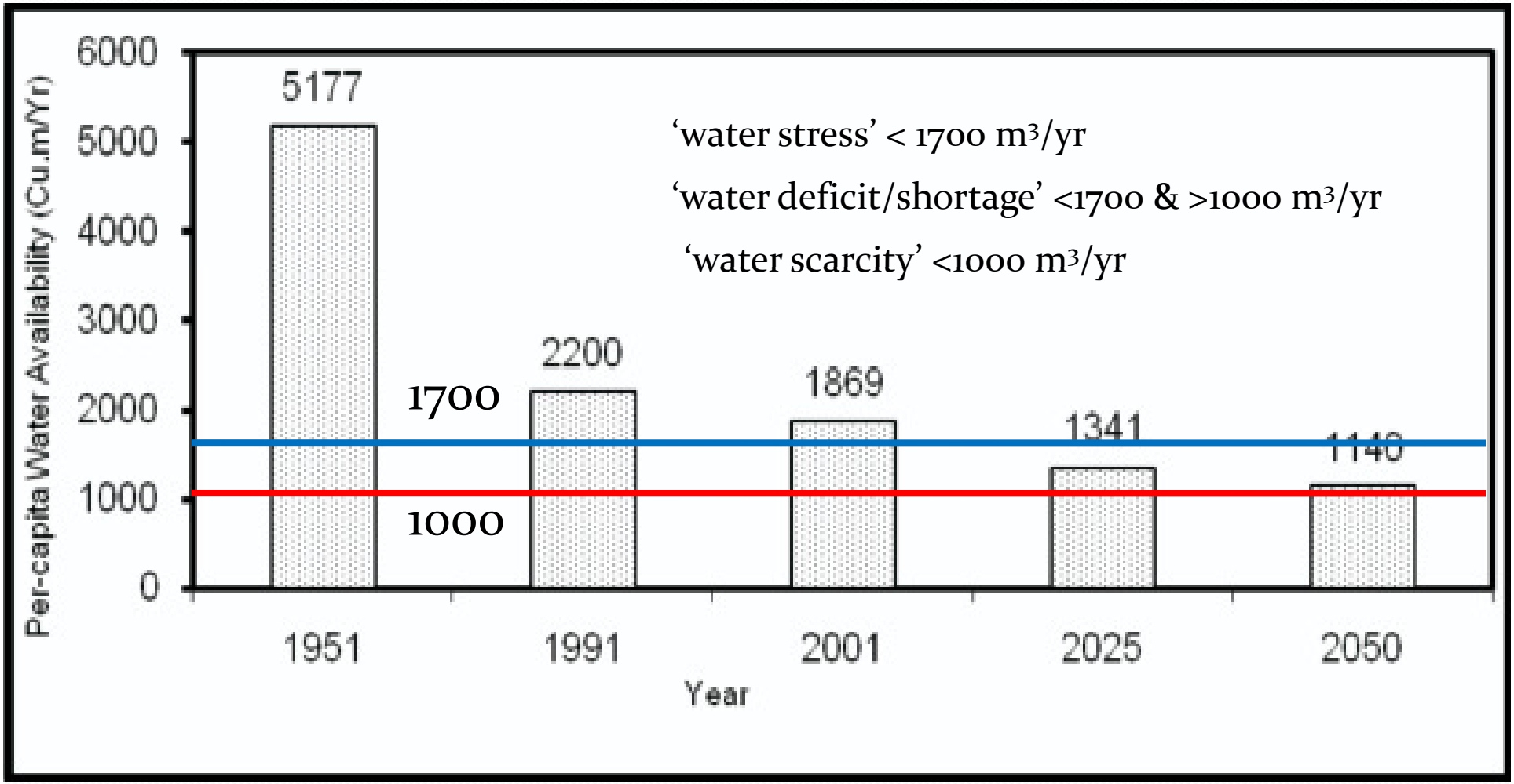


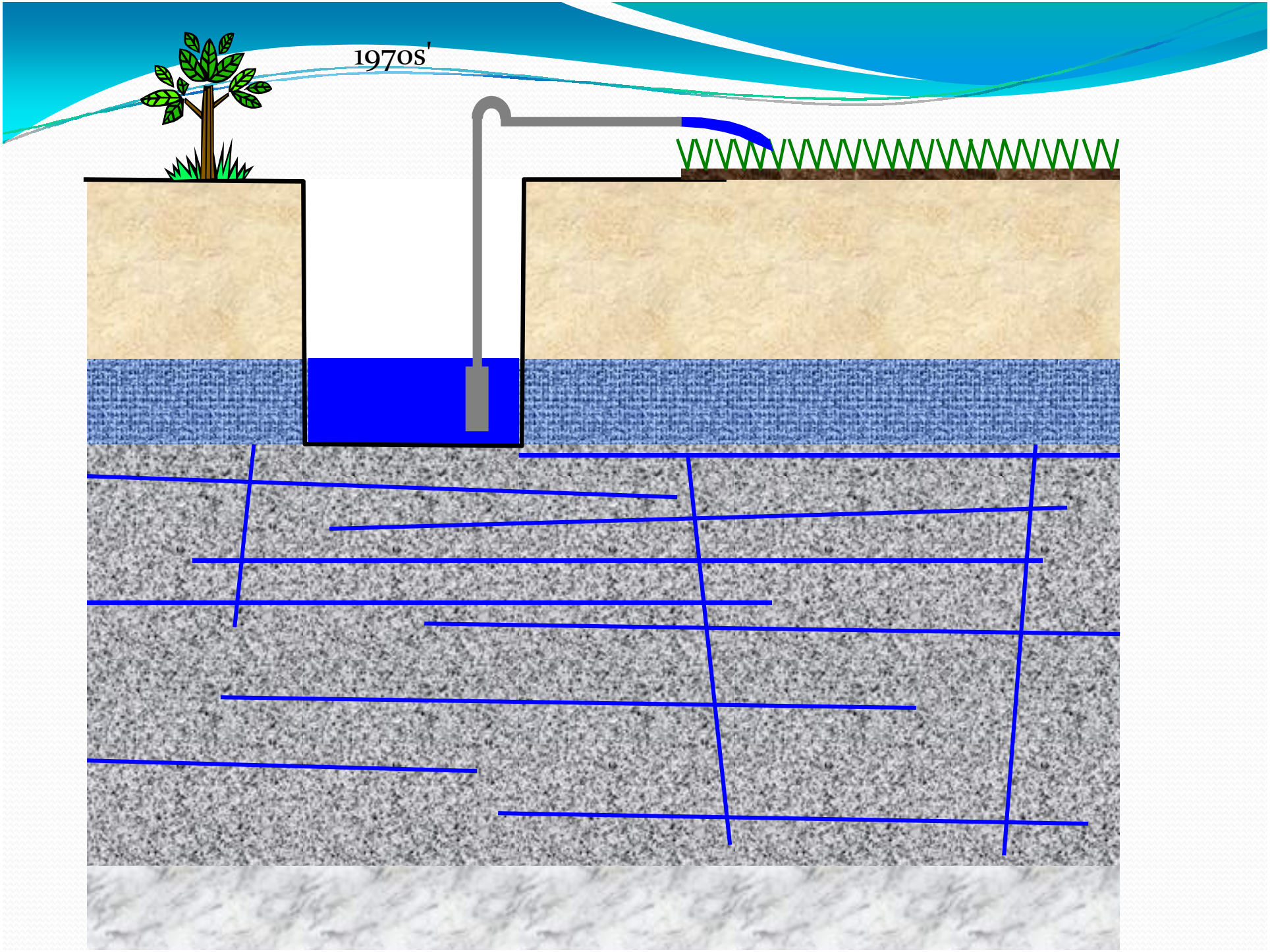
FALKENMARK WATER STRESS INDICATOR (Falkenmark & Lindh, 1976)

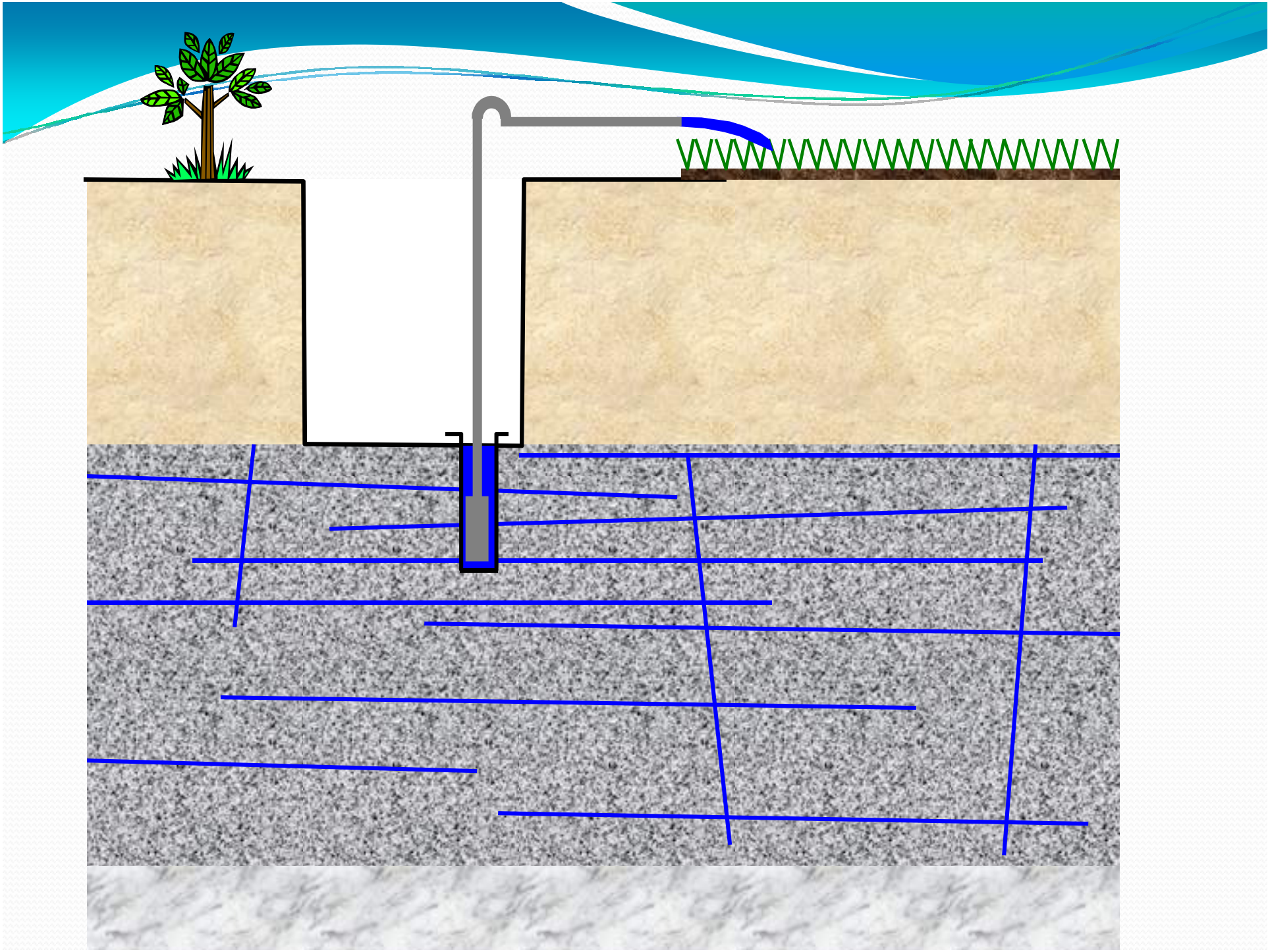
- 'Water Stress' < 1700 m^3/yr
- 'Water Deficit/Shortage'

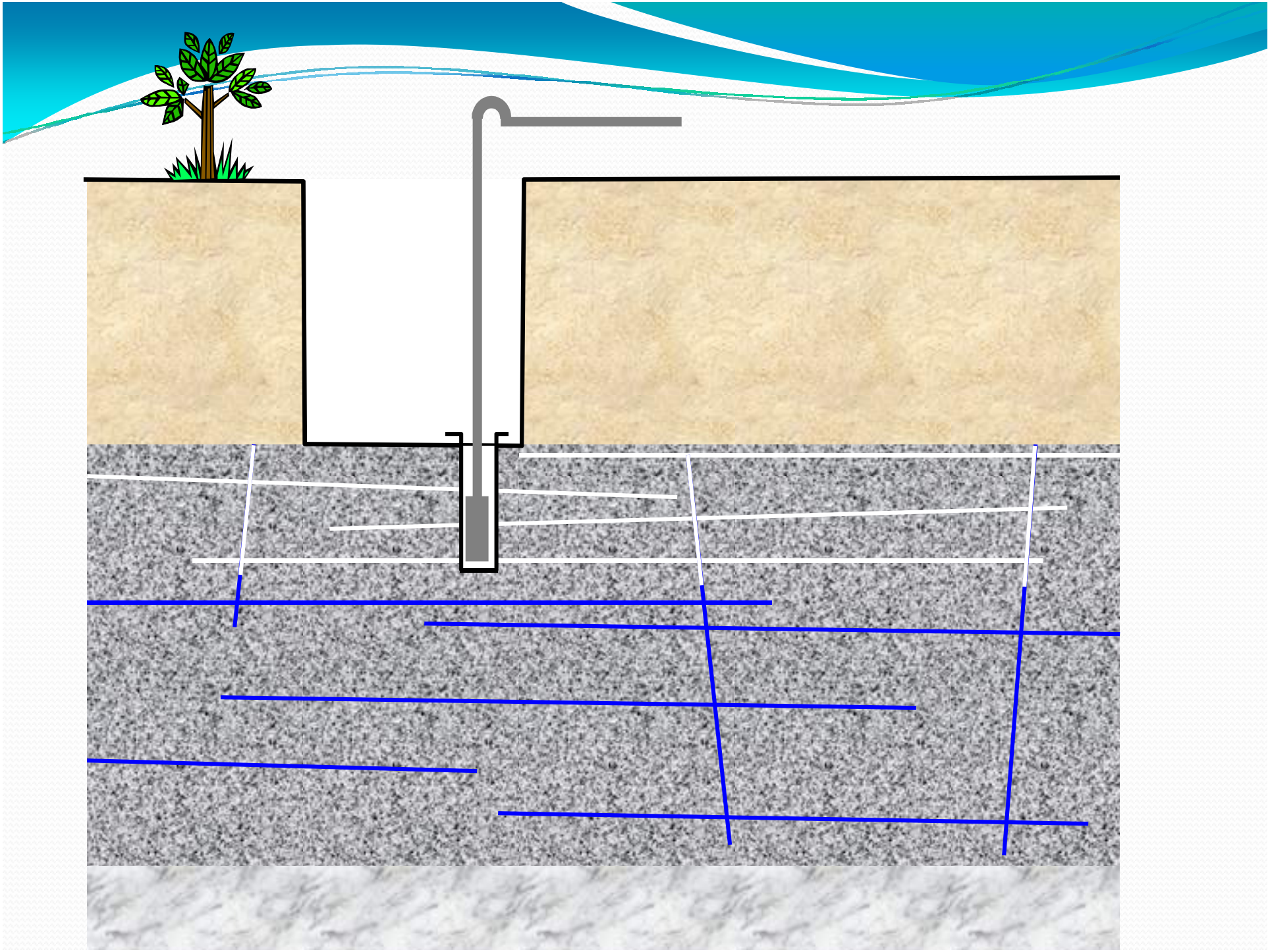
  <1700 & >1000 m^3/yr
- 'Water Scarcity' <1000 m^3/yr

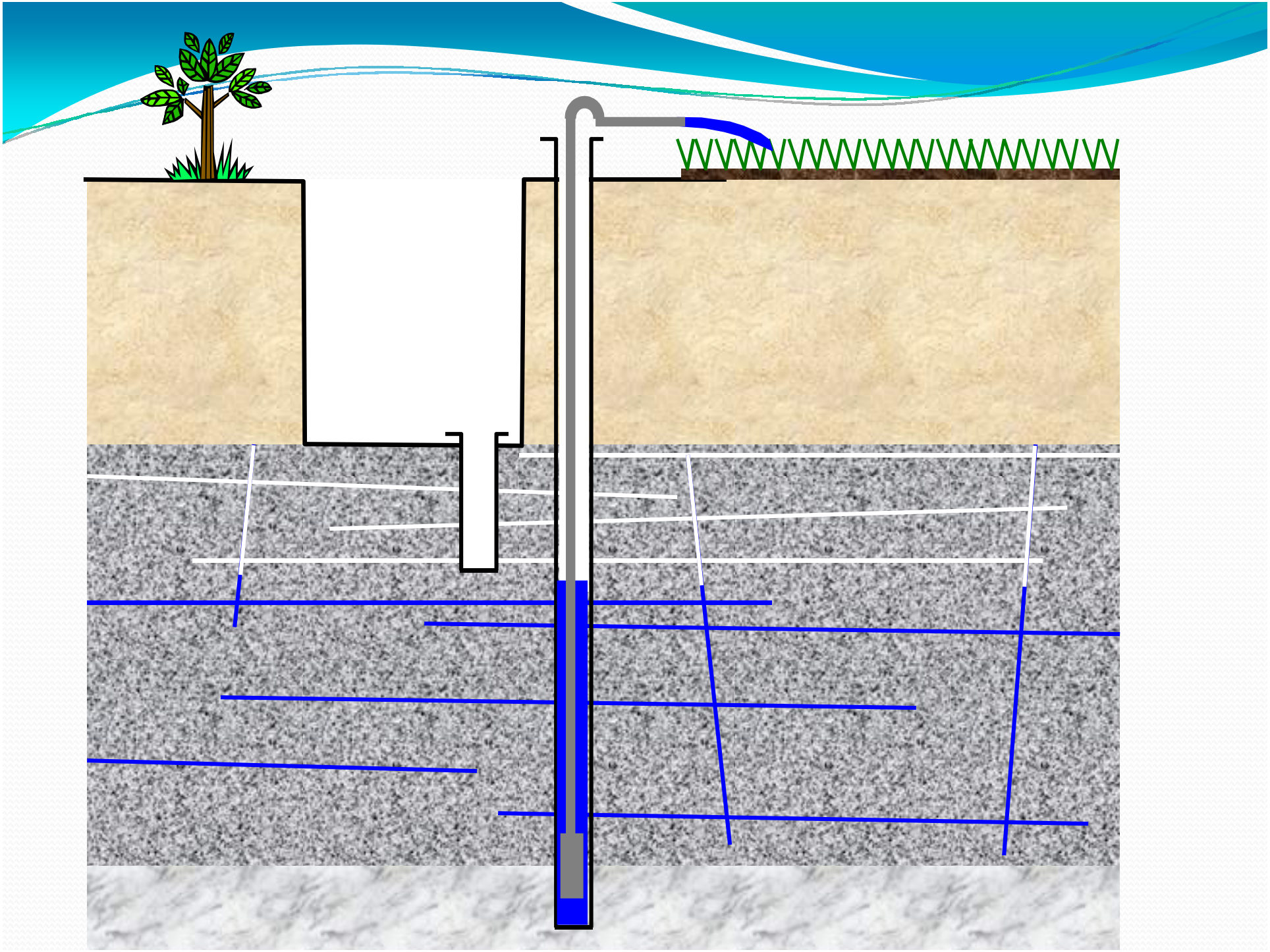
FALKENMARK WATER STRESS INDICATOR

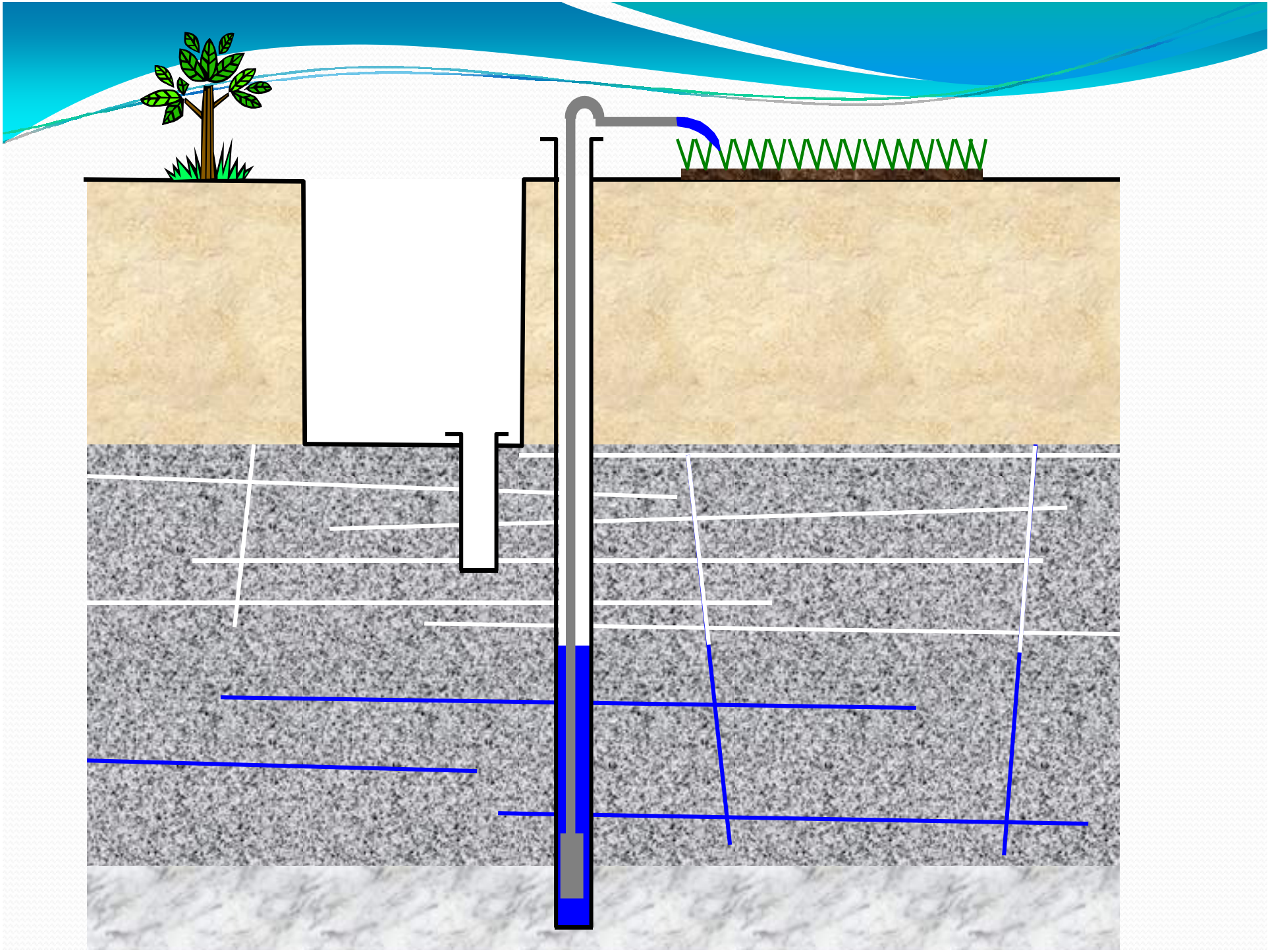


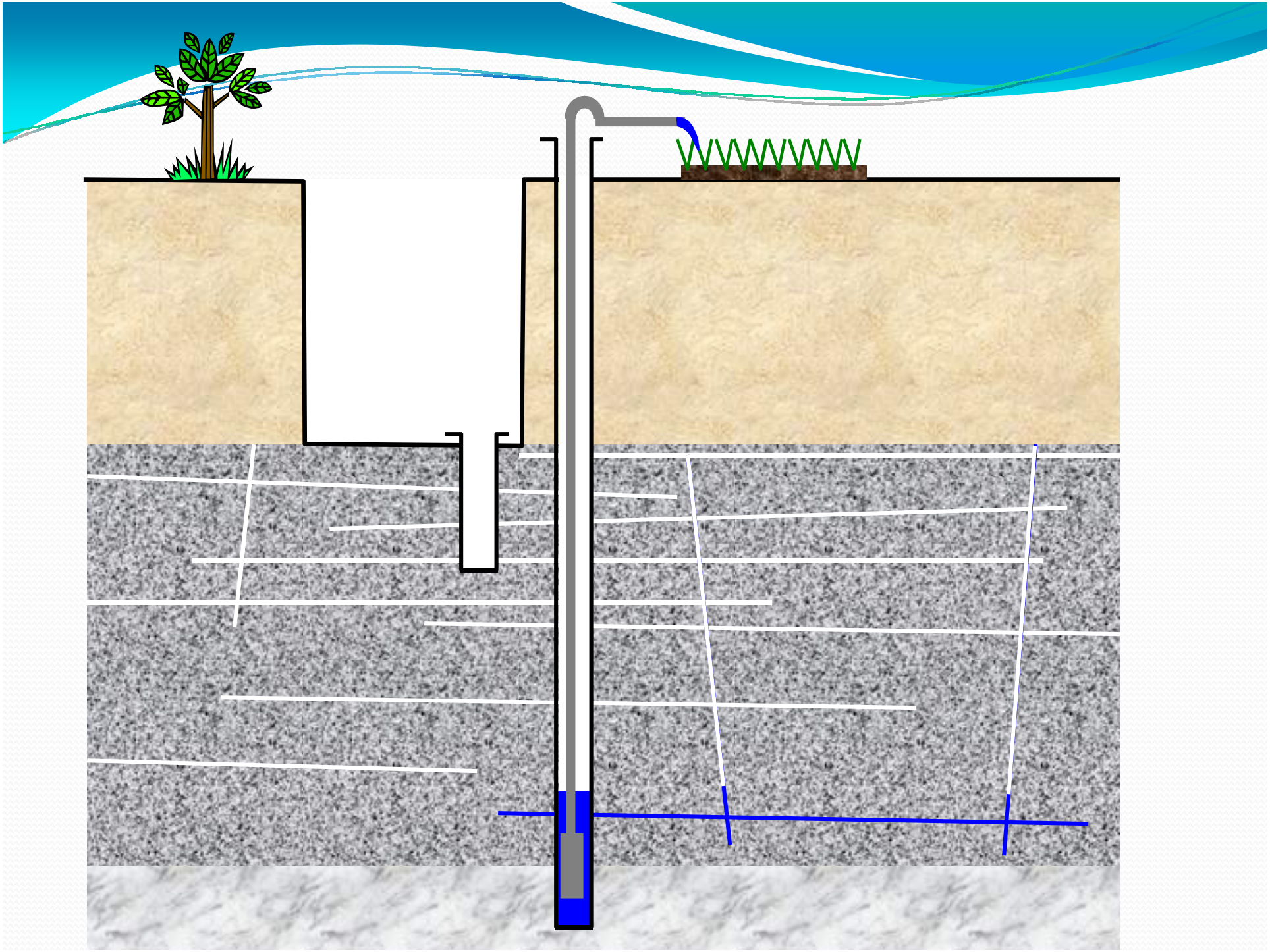

1970s'

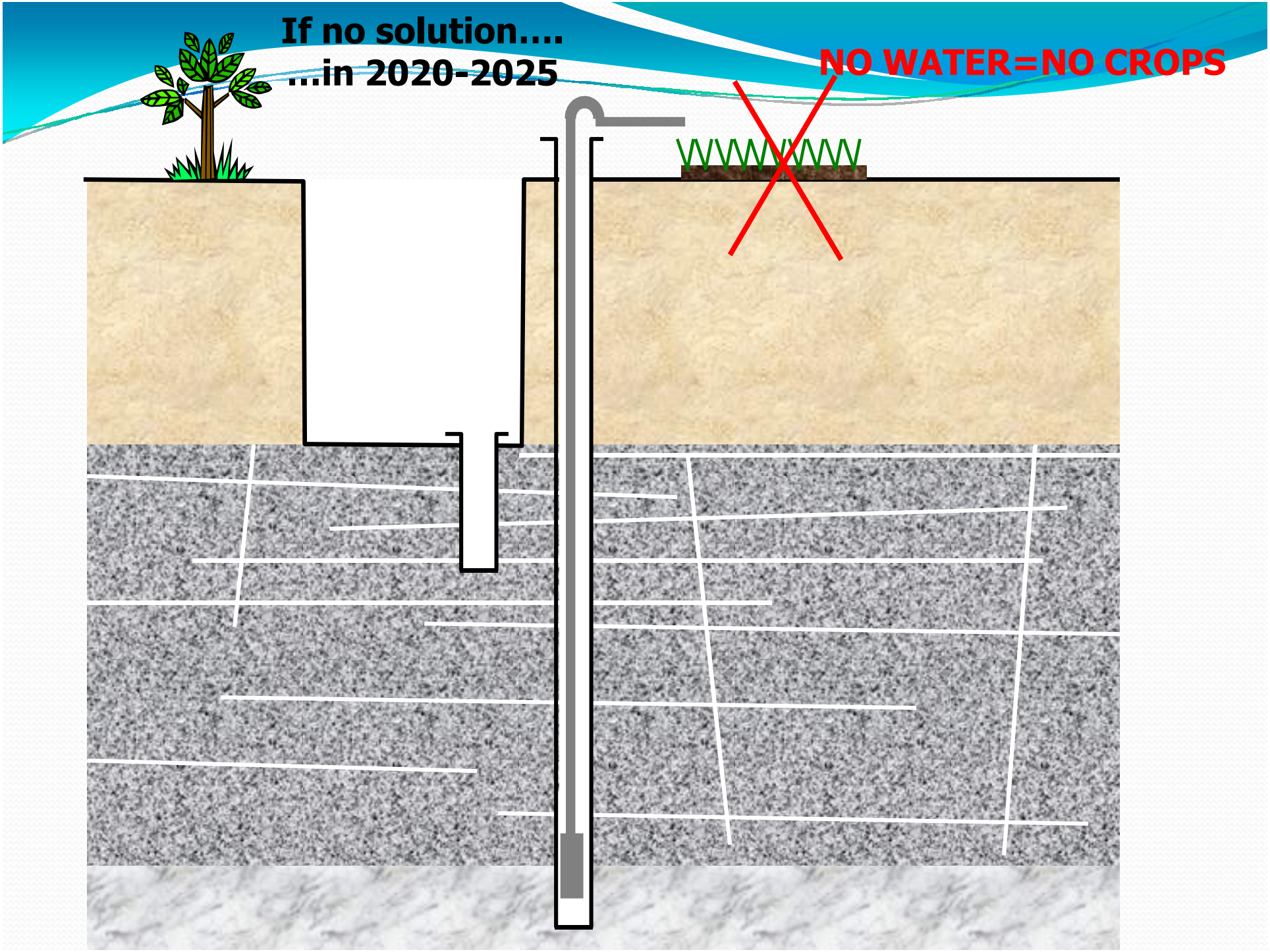











If no solution….
…in 2020-2025
NO WATER=NO CROPS

CHALLENGES TO AGRICULTURAL SECTOR

- Deteriorating natural resource base.
- Declining trends of water levels.
- Over-exploitation of ground water resources.
- Declining trends of water quality.
- Stagnation of yields of principal crops.
- Declining farm income.
- Increasing rural debt.

WHAT IS THE SOLUTION?

- Supply side Management
- Demand side Management

GW MANAGEMENT OPTIONS

- Ground water resources management
  - Supply-side management
    - Managed aquifer recharge (MAR)
  - Demand-side management
    - Water use efficiency
    - Regulations
    - Public awareness

WHAT IS MAR?

Purposeful recharge of water to aquifers for subsequent recovery or environmental benefit.

(International Association of Hydrogeologists)

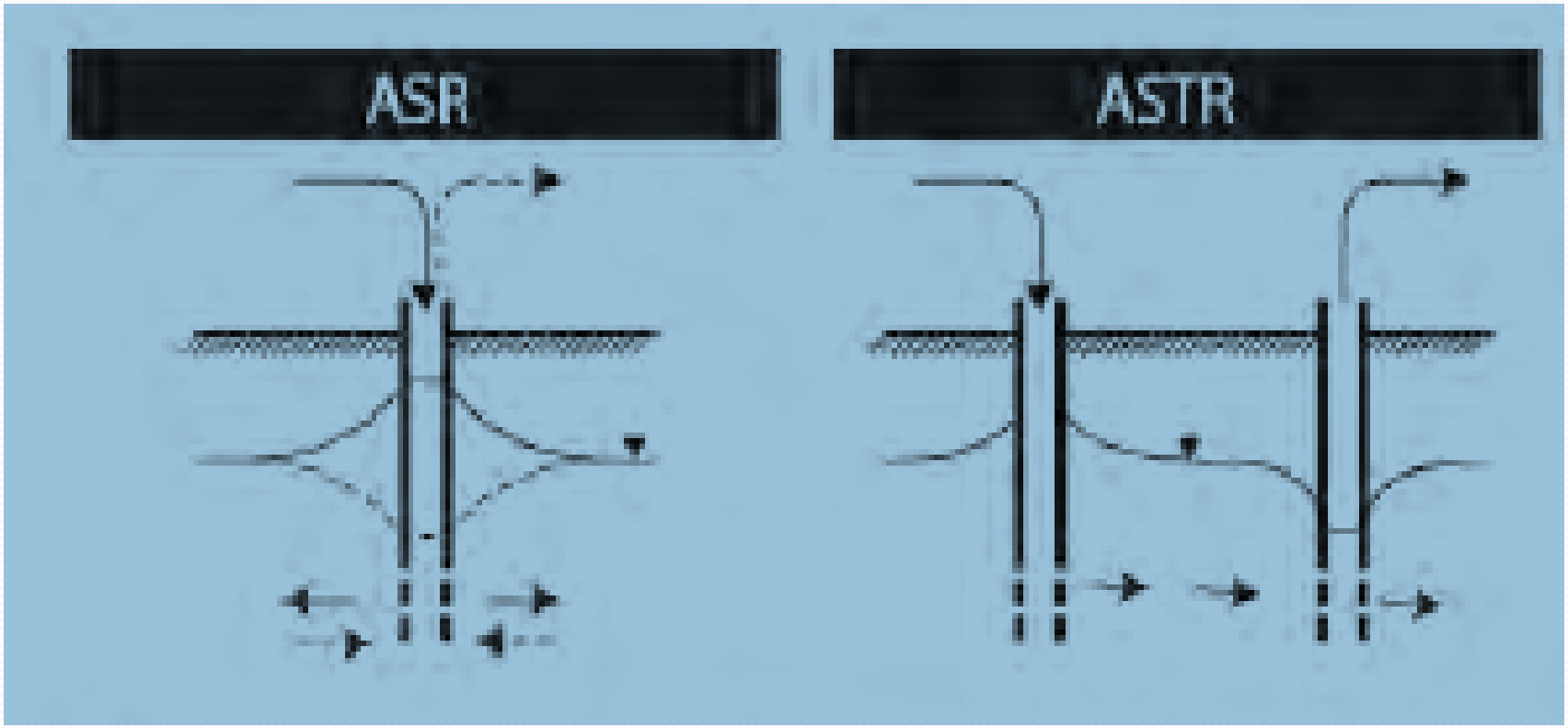
WHAT IS AN AQUIFER?

An aquifer is an underground layer of water-bearing permeable rock, rock fractures or unconsolidated materials (gravel, sand, or silt) from which ground water can be extracted sufficiently using a water well.

OTHER RELEVANT TERMS

- ASR (Aquifer Storage and Recovery).
- ASTR (Aquifer Storage, Transfer and Recovery).

ASR & ASTR



HUMAN ACTIVITIES ENHANCING AQUIFER RECHARGE

- Unintentional .
- Unmanaged.
- Managed.

WHY MAR?

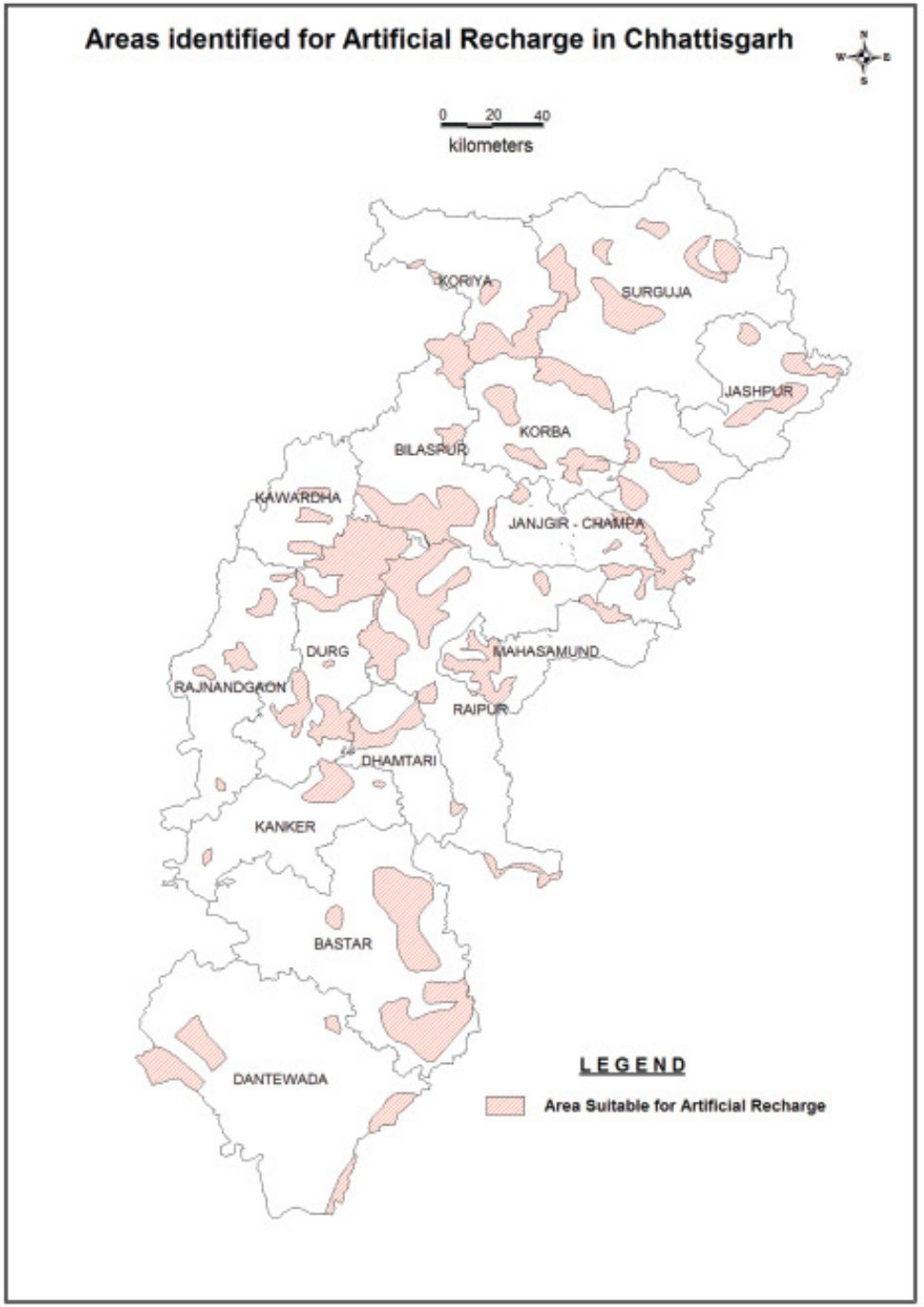
- To secure and enhance water supplies.
- To improve groundwater quality.
- To prevent salt water intrusion.
- To reduce evaporation of stored water.
- To maintain environmental flows and groundwater-dependent ecosystems.

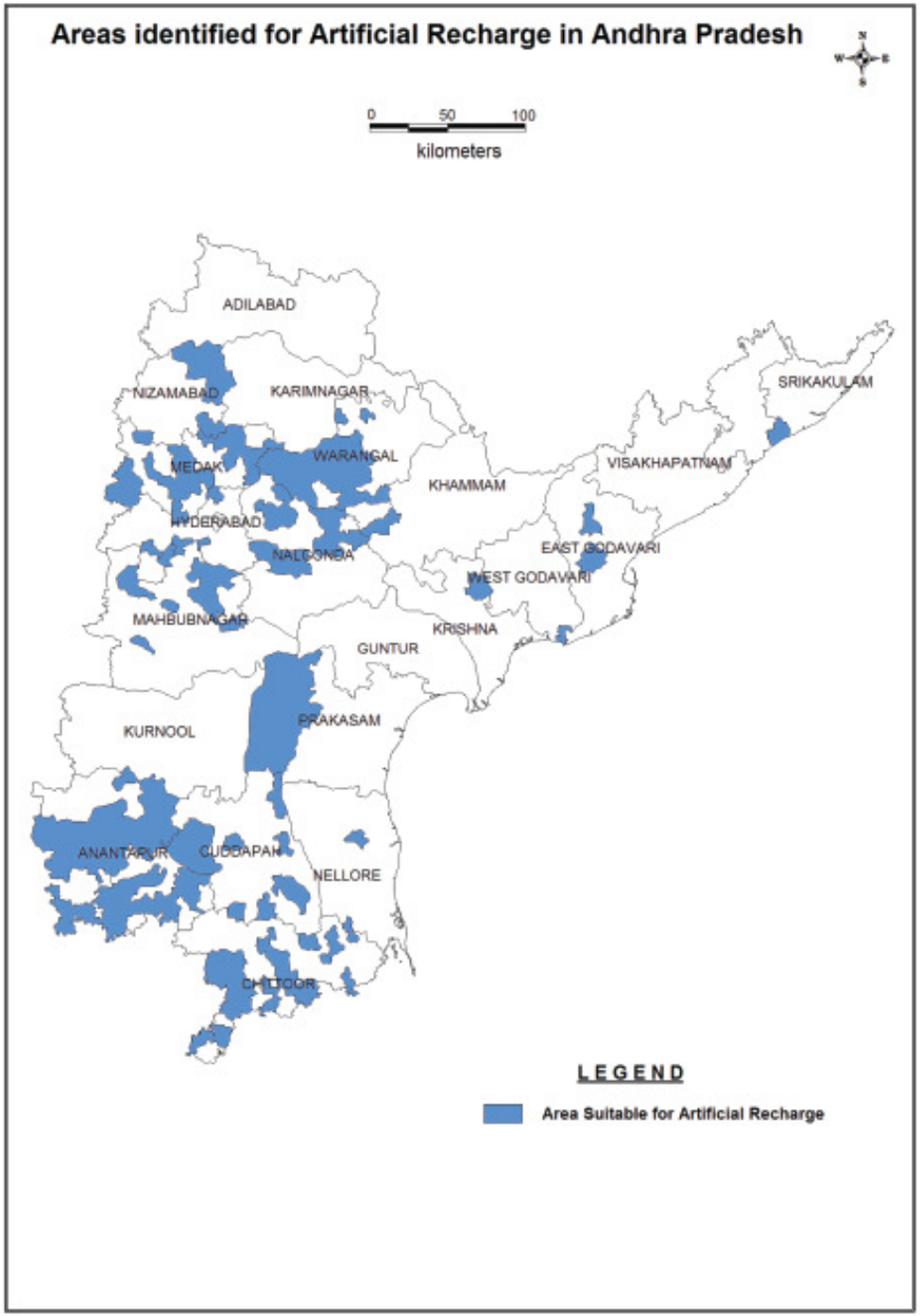
METHODOLOGY FOR PREPARATION OF MASTER PLAN

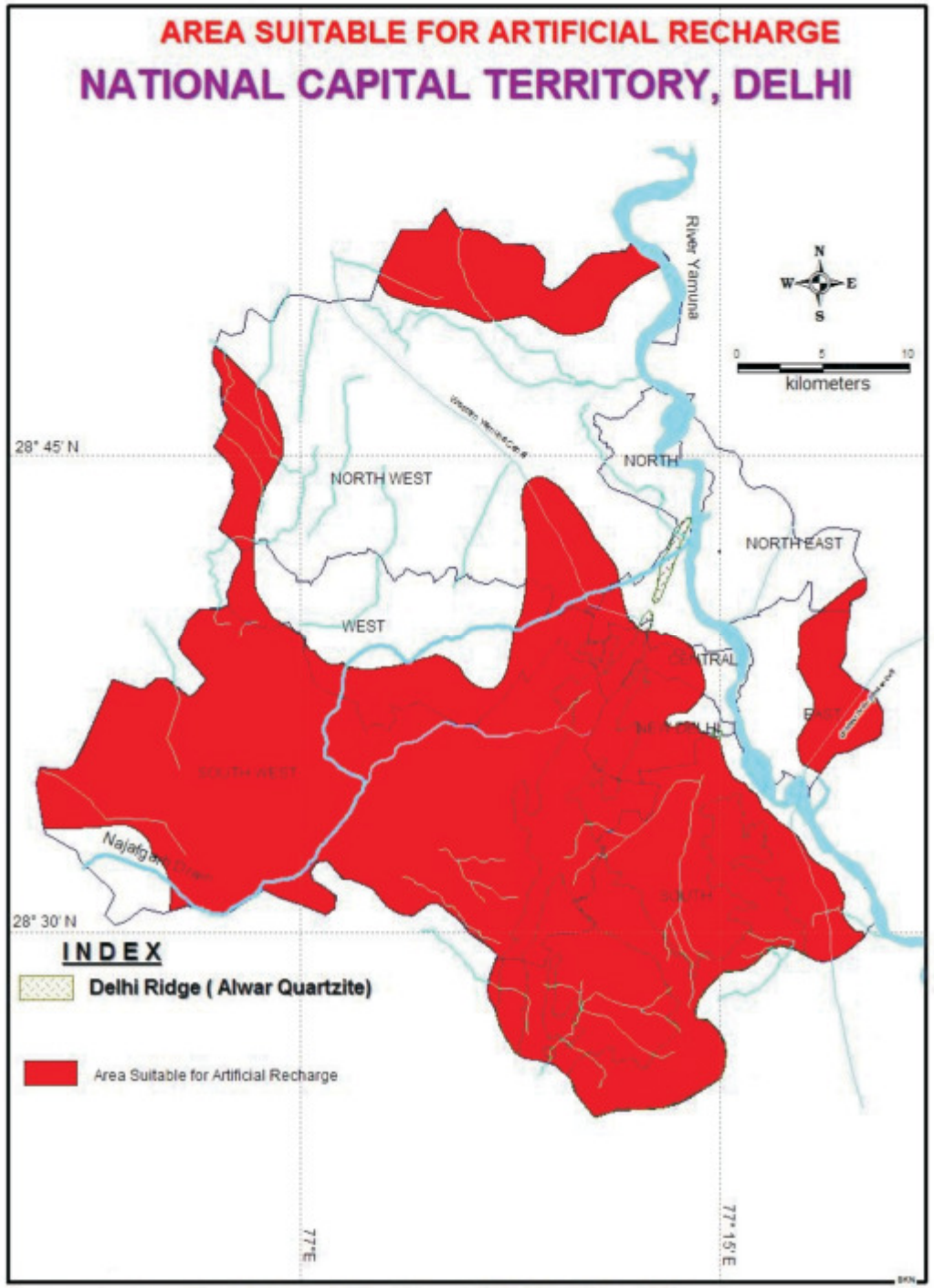
- Identification and prioritization of need based areas.
- Estimation of subsurface storage space.
- Quantification of local surplus annual run off.
- Areas of poor chemical quality of ground water and scope of improvement by recharge.
- Working out design of suitable recharge structures, their numbers and type.
- Cost estimates of artificial recharge structures.

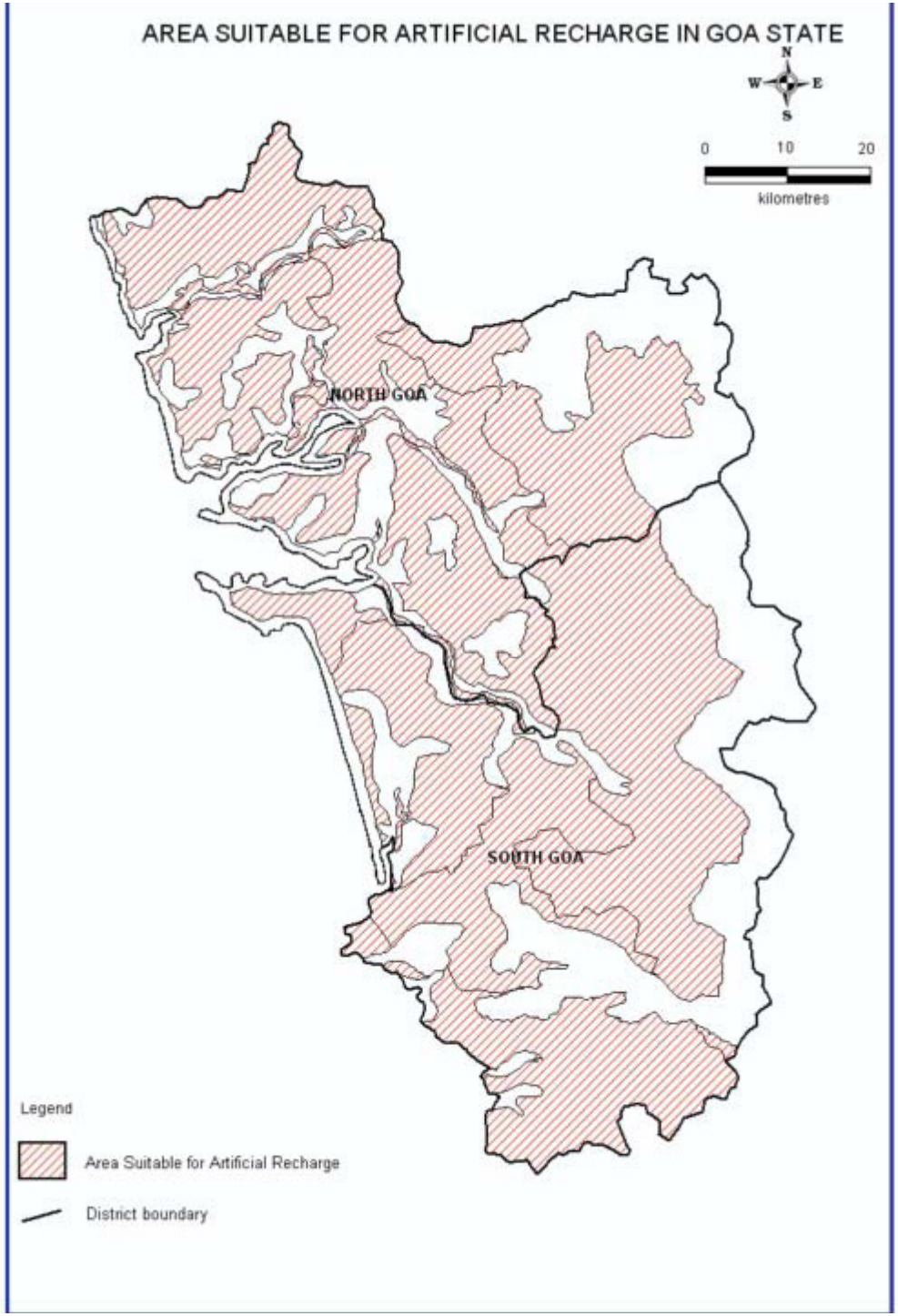
IDENTIFICATION OF FEASIBLE AREAS

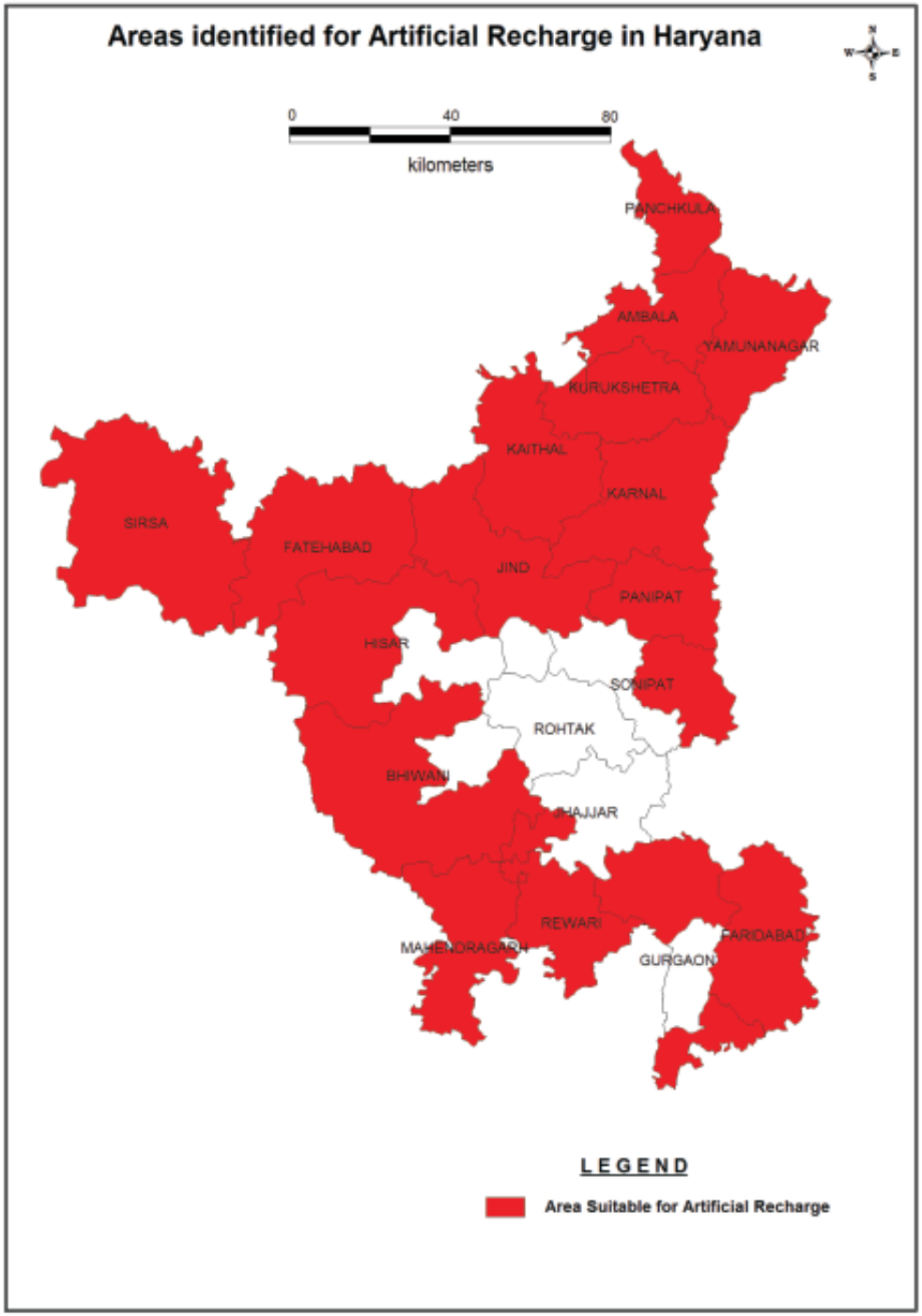
- Areas with post-monsoon water level >3 m bgl and declining trend of more than 10 cm/year in plains.
- Post-monsoon water level above 4 to 8 m bgl in undulating/ hilly terrains.
- Areas with deeper pressure head in known principal aquifers.
- Areas having less fresh water lenses in coastal/island aquifers.

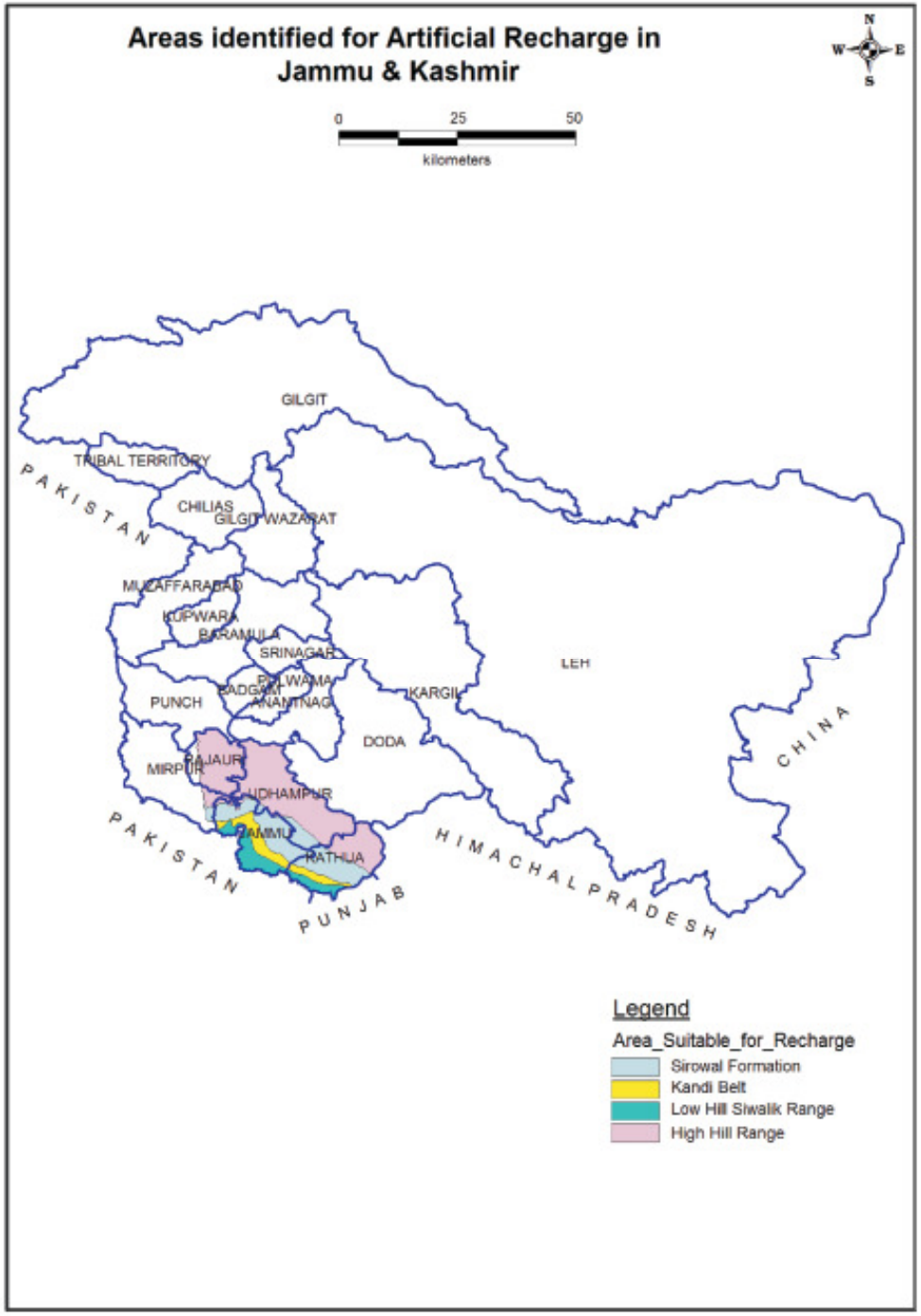

Areas identified for Artificial Recharge in Chhattisgarh
0 20 40
kilometers
KORIYA
SURGUJA
JASHPUR
KORBA
BILASPUR
KAWARDHA
JANJGIR - CHAMPA
DURG
MAHASAMUND
RAJNANDGAON
RAIPUR
DHAMTARI
KANKER
BASTAR
DANTEWADA
LEGEND
Area Suitable for Artificial Recharge


Areas identified for Artificial Recharge in Andhra Pradesh
N
W
E
S
0
50
100
kilometers
ADILABAD
NIZAMABAD
KARIMNAGAR
WARANGAL
MEDAK
KHAMMAM
HYDERABAD
NALGONDA
MAHBUBNAGAR
GUNTUR
KRISHNA
PRAKASAM
KURNOOL
ANANTAPUR
CUDDAPAH
NELLORE
CHITTOOR
SRIKAKULAM
VISAKHAPATNAM
EAST GODAVARI
WEST GODAVARI
LEGEND
Area Suitable for Artificial Recharge


AREA SUITABLE FOR ARTIFICIAL RECHARGE
NATIONAL CAPITAL TERRITORY, DELHI
River Yamuna
N
W
E
S
0
5
10
kilometers
28° 45' N
NORTH WEST
NORTH
NORTH EAST
WEST
CENTRAL
28° 30' N
INDEX
Delhi Ridge (Alwar Quartzite)
Area Suitable for Artificial Recharge
77°E
77° 15'E

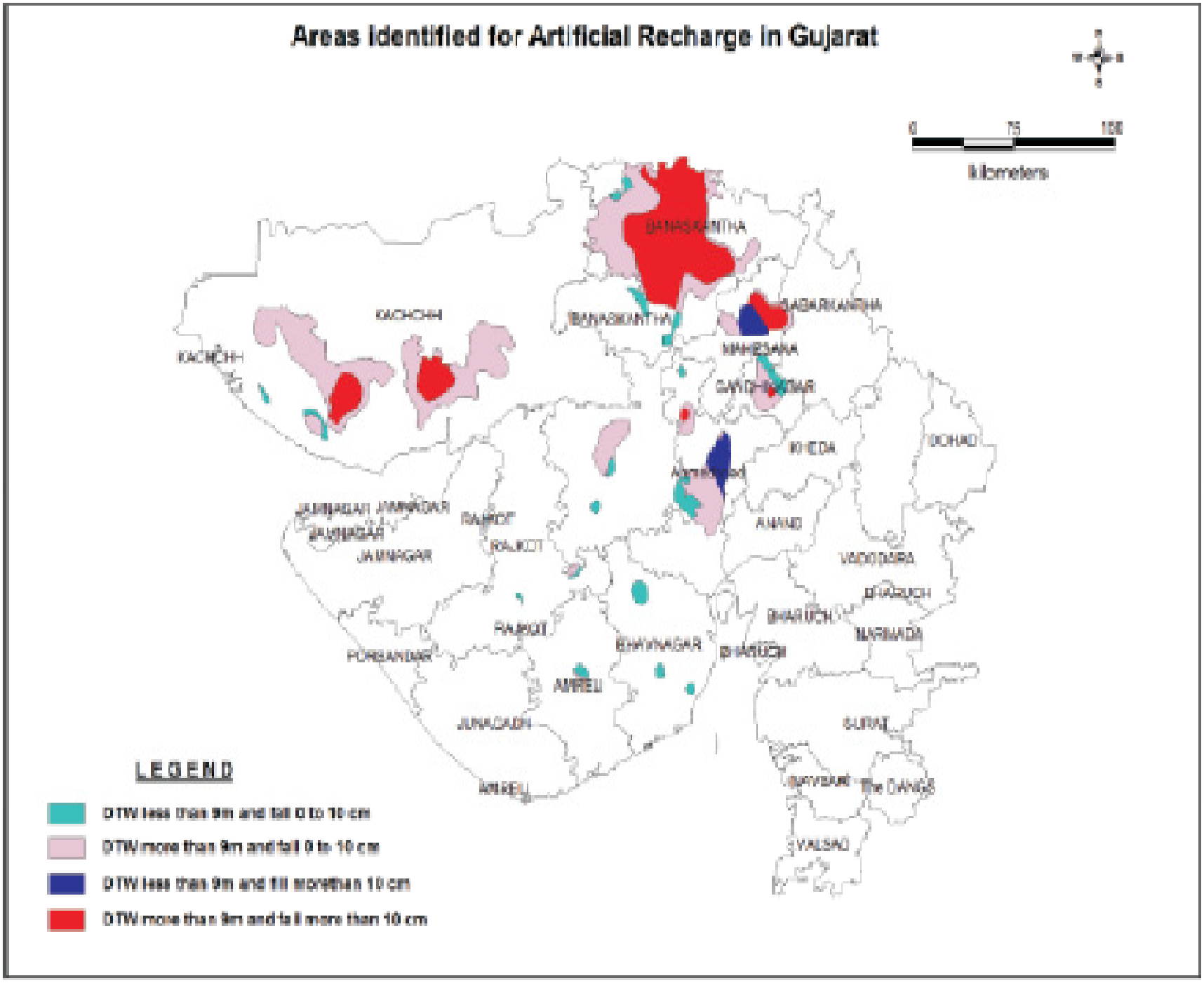

AREA SUITABLE FOR ARTIFICIAL RECHARGE IN GOA STATE
N
W
E
S
0
10
20
kilometres
NORTH GOA
SOUTH GOA
Legend
Area Suitable for Artificial Recharge
District boundary

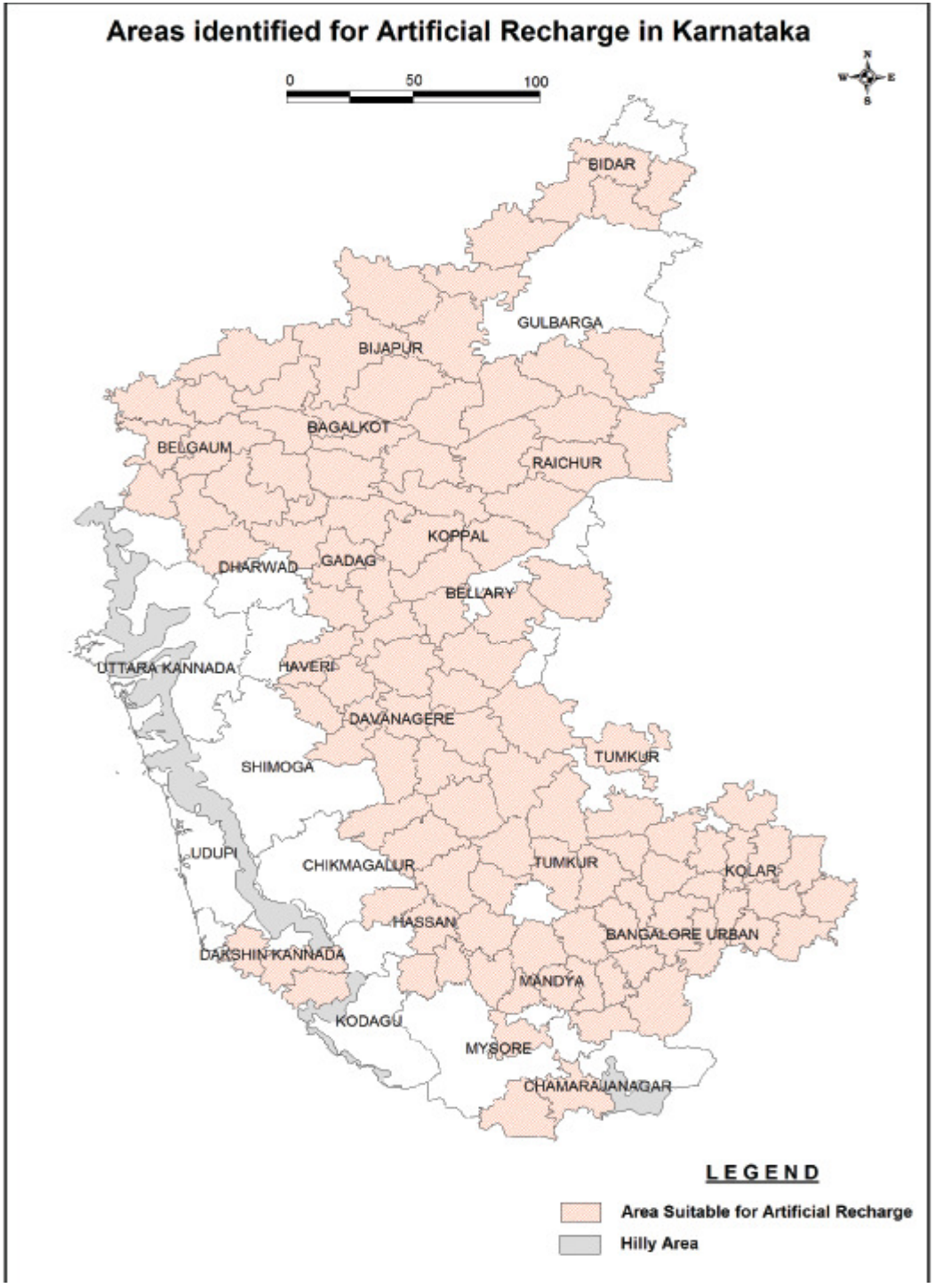

Areas identified for Artificial Recharge in Haryana
0
40
80
kilometers
PANCHKULA
AMBALA
YAMUNANAGAR
KURUKSHETRA
KAITHAL
KARNAL
SIRSA
FATEHABAD
JIND
PANIPAT
HISAR
SONIPAT
ROHTAK
BHIWANI
JHAJJAR
REWARI
FARIDABAD
MAHENDRAGARH
GURGAON
LEGEND
Area Suitable for Artificial Recharge


Areas identified for Artificial Recharge in Jammu & Kashmir
N
W
E
S
0
25
50
kilometers
GILGIT
TRIBAL TERRITORY
PAKISTAN
CHILIAS
GILGIT WAZARAT
MUZAFFARABAD
KUPWARA
BARAMULA
SRINAGAR
PULWAMA
BADGAM
ANANTNAG
PUNCH
KARGIL
LEH
DODA
CHINA
RAJAURI
MIRPUR
UDHAMPUR
JAMMU
KATHUA
PAKISTAN PUNJAB
HIMACHAL PRADESH
Legend
Area_Suitable_for_Recharge
Sirowal Formation
Kandi Belt
Low Hill Siwalik Range
High Hill Range

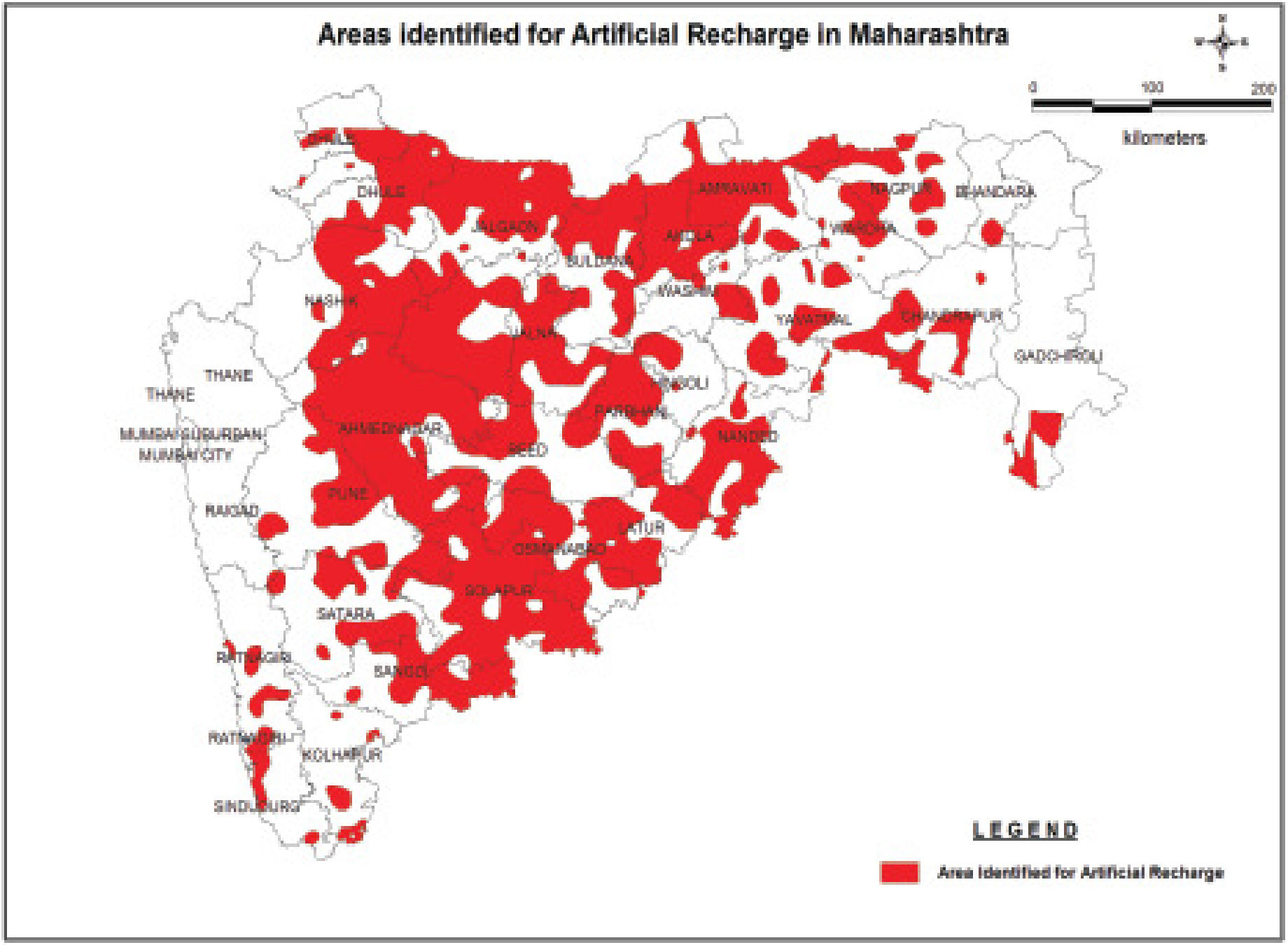

Areas identified for Artificial Recharge in Jharkhand
0 20 40
kilometers
SAHIBGANJ
GODDA
KODARMA
PAKAUR
GIRIDH
DEOGHAR
DUMKA
GARHWA
PALAMU
CHATRA
HAZARIBAG
DHANBAD
BOKARO
LOHARDAGA
RANCHI
GUMLA
PASHCHIM SINGHBHUM
LEGEND
DTW level 5.7 mbgl having declining trend < 0.1 m/year
DTW level 5.7 mbgl having declining trend > 0.1 m/year
DTW level > 7 mbgl having declining trend < 0.1 m/year
DTW level < 7 mbgl having declining trend > 0.1 m/year

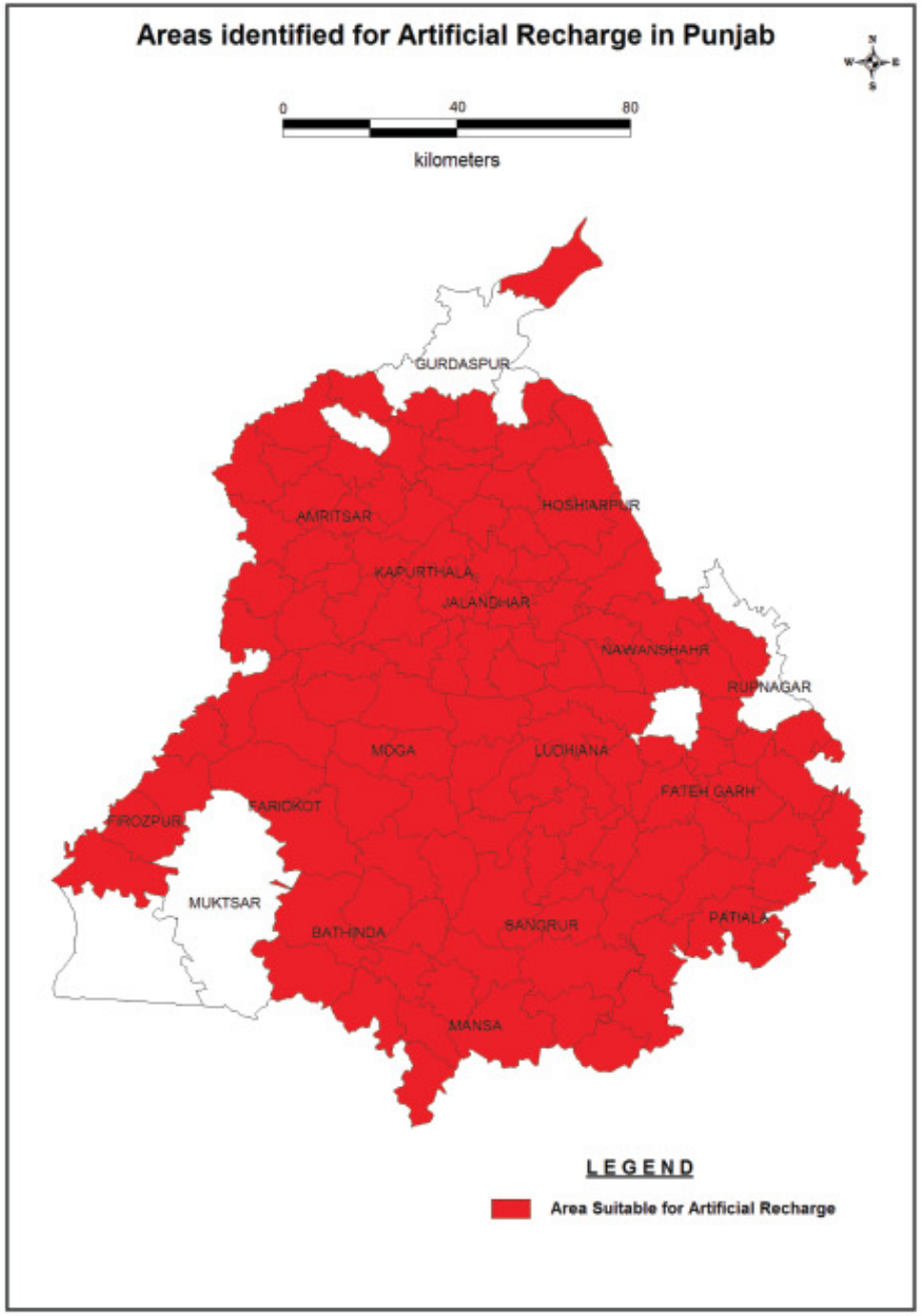
Areas identified for Artificial Recharge in Gujarat

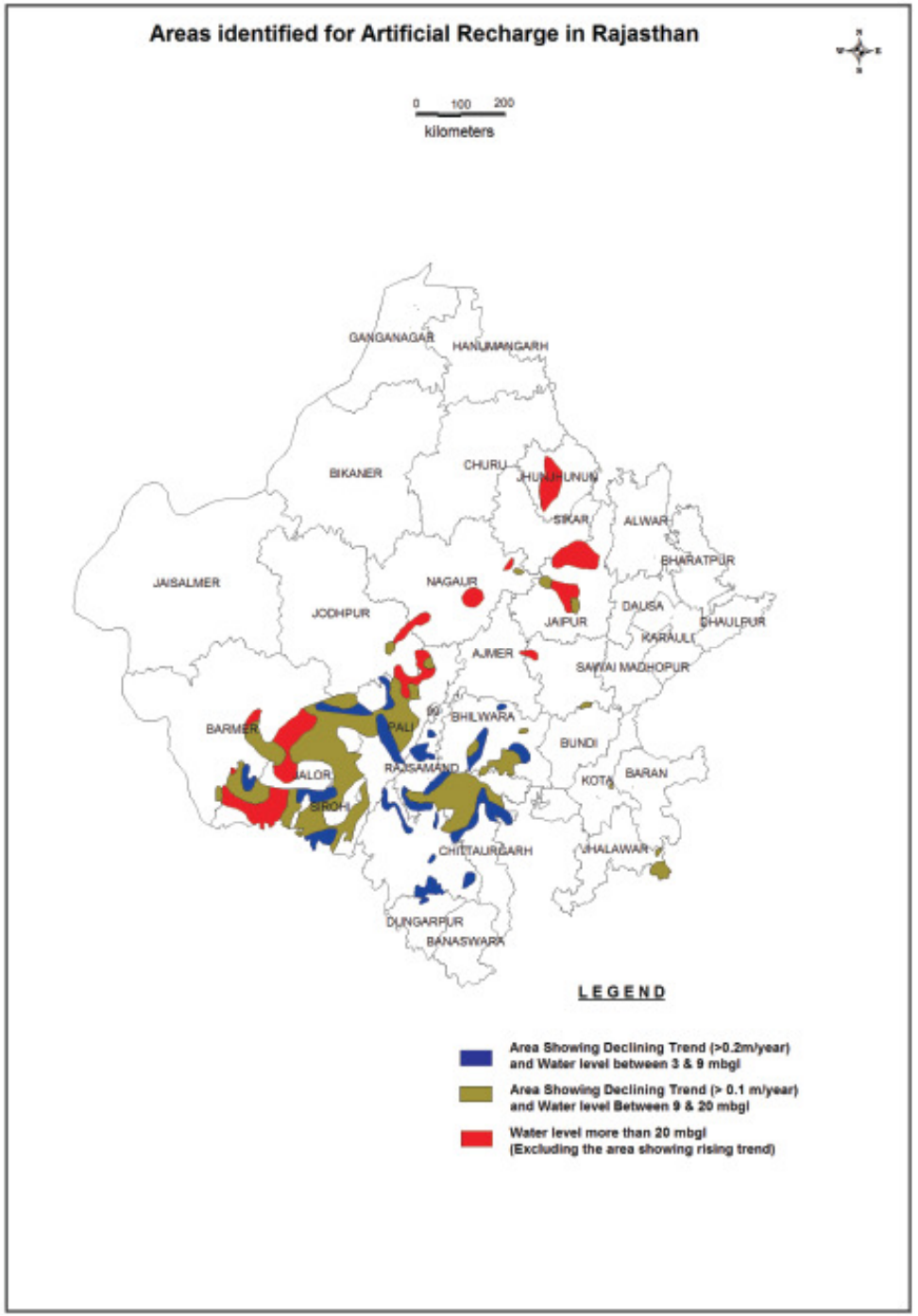


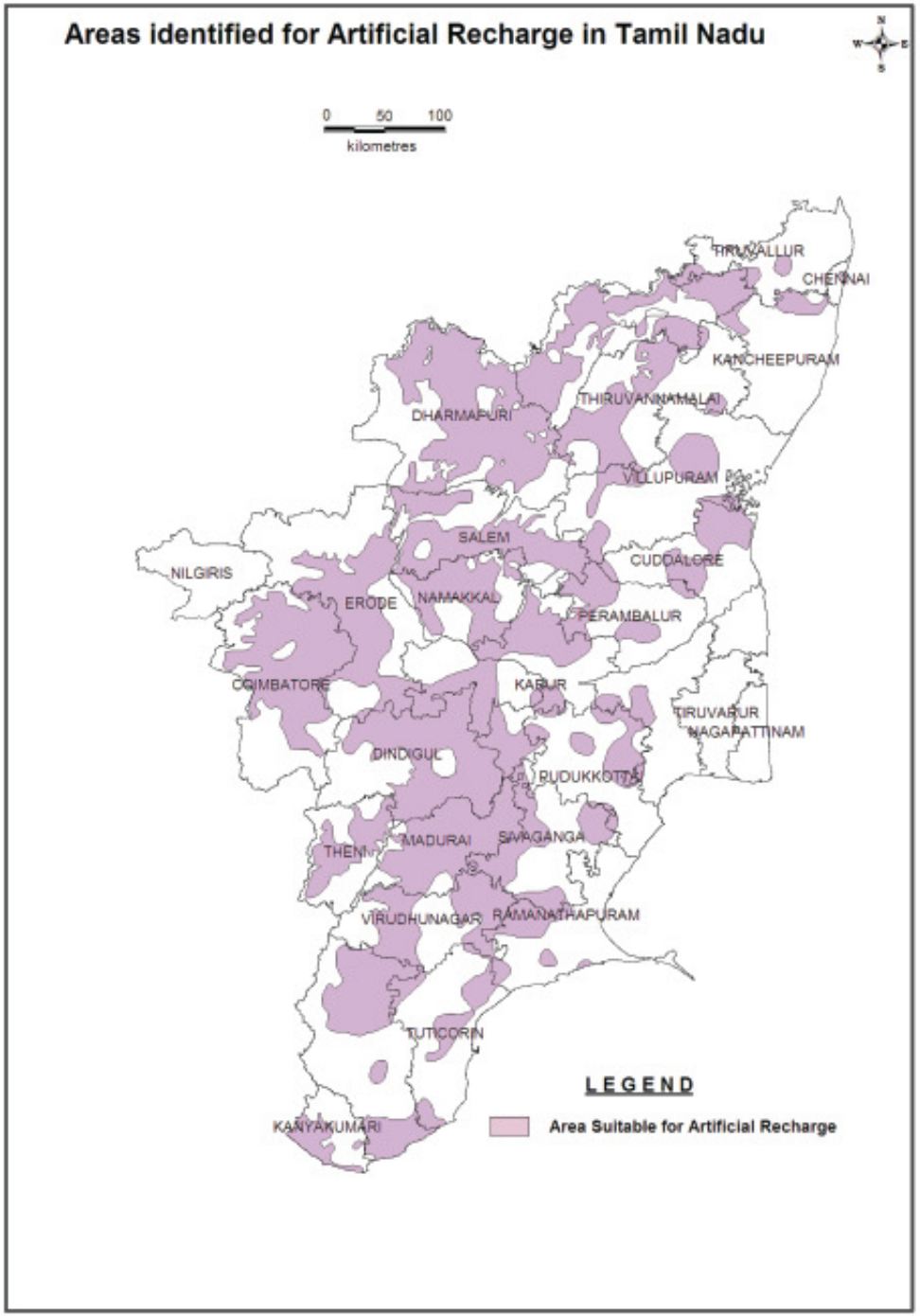

Areas identified for Artificial Recharge in Karnataka
0
50
100
N
W
E
S
BIDAR
GULBARGA
BIJAPUR
BAGALKOT
BELGAUM
RAICHUR
KOPPAL
GADAG
DHARWAD
BELLARY
UTTARA KANNADA
HAVERI
DAVANAGERE
TUMKUR
SHIMOGA
UDUPI
CHIKMAGALUR
TUMKUR
KOLAR
HASSAN
BANGALORE URBAN
DARSHIN KANNADA
MANDYA
KODAGU
MYSORE
CHAMARAJANAGAR
LEGEND
Area Suitable for Artificial Recharge
Hilly Area

Areas identified for Artificial Recharge in Maharashtra

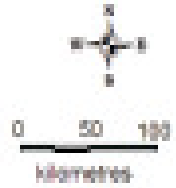



Areas identified for Artificial Recharge in Punjab
0
40
80
kilometers
GURDASPUR
AMRITSAR
HOSHIARPUR
KAPURTHALA
JALANDHAR
NAWANSHAHR
RUPNAGAR
MOGA
LUDHIANA
FATEH GARH
FARIDKOT
FIROZPUR
MUKTSAR
BATHINDA
SANGRUR
PATIALA
MANSA
LEGEND
Area Suitable for Artificial Recharge


Areas identified for Artificial Recharge in Rajasthan
0 100 200
kilometers
GANGANAGAR
HANUMANGARH
BIKANER
CHURU
JHUNJHUNUN
SIKAR
ALWAR
BHARATPUR
JAISALMER
NAGAUR
DAUSA
JODHPUR
JAIPUR
DHAULPUR
KARAULI
AJMER
SAWAI MADHOPUR
BHILWARA
BARMER
PALI
BUNDI
RAJSAMAND
JALOR
KOTA
BARAN
SIROHI
CHITTAURGARH
JHALAWAR
DUNGARPUR
BANASWARA
LEGEND
Area Showing Declining Trend (>0.2m/year) and Water level between 3 & 9 mbgl
Area Showing Declining Trend (> 0.1 m/year) and Water level Between 9 & 20 mbgl
Water level more than 20 mbgl (Excluding the area showing rising trend)

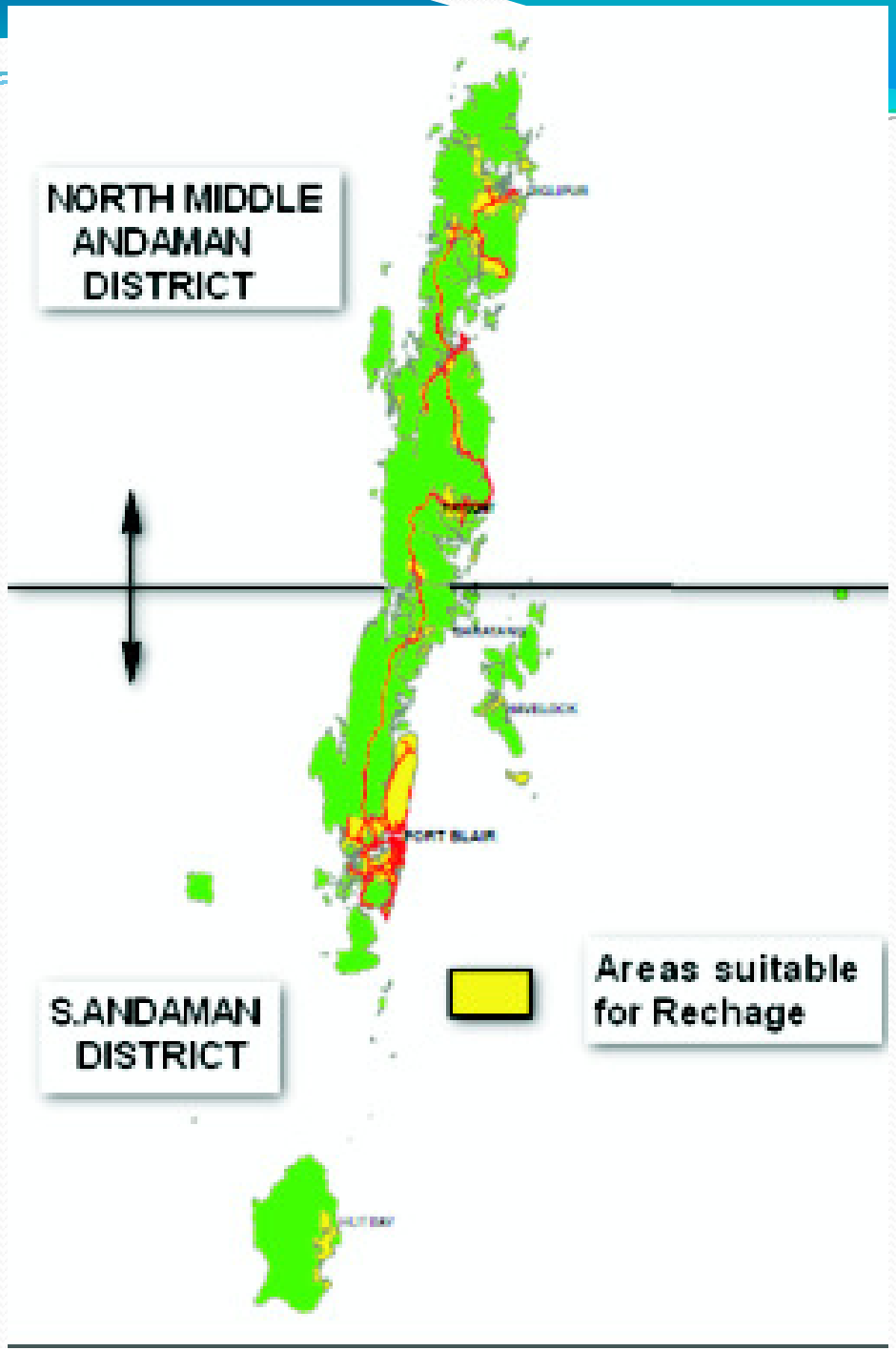

Areas identified for Artificial Recharge in Tamil Nadu
0 50 100
kilometres
TIRUVALLUR
CHENNAI
KANCHEEPURAM
THIRUVANNAMALAI
DHARMAPURI
VILLUPURAM
SALEM
CUDDALORE
NILGIRIS
ERODE
NAMAKKAL
PERAMBALUR
COIMBATORE
KARUR
TIRUVARUR
NAGAPATTINAM
DINDIGUL
PUDUKKOTTAI
MADURAI
SIVAGANGA
THENI
VIRUDHUNAGAR
RAMANATHAPURAM
TUTICORIN
KANYAKUMARI
LEGEND
Area Suitable for Artificial Recharge

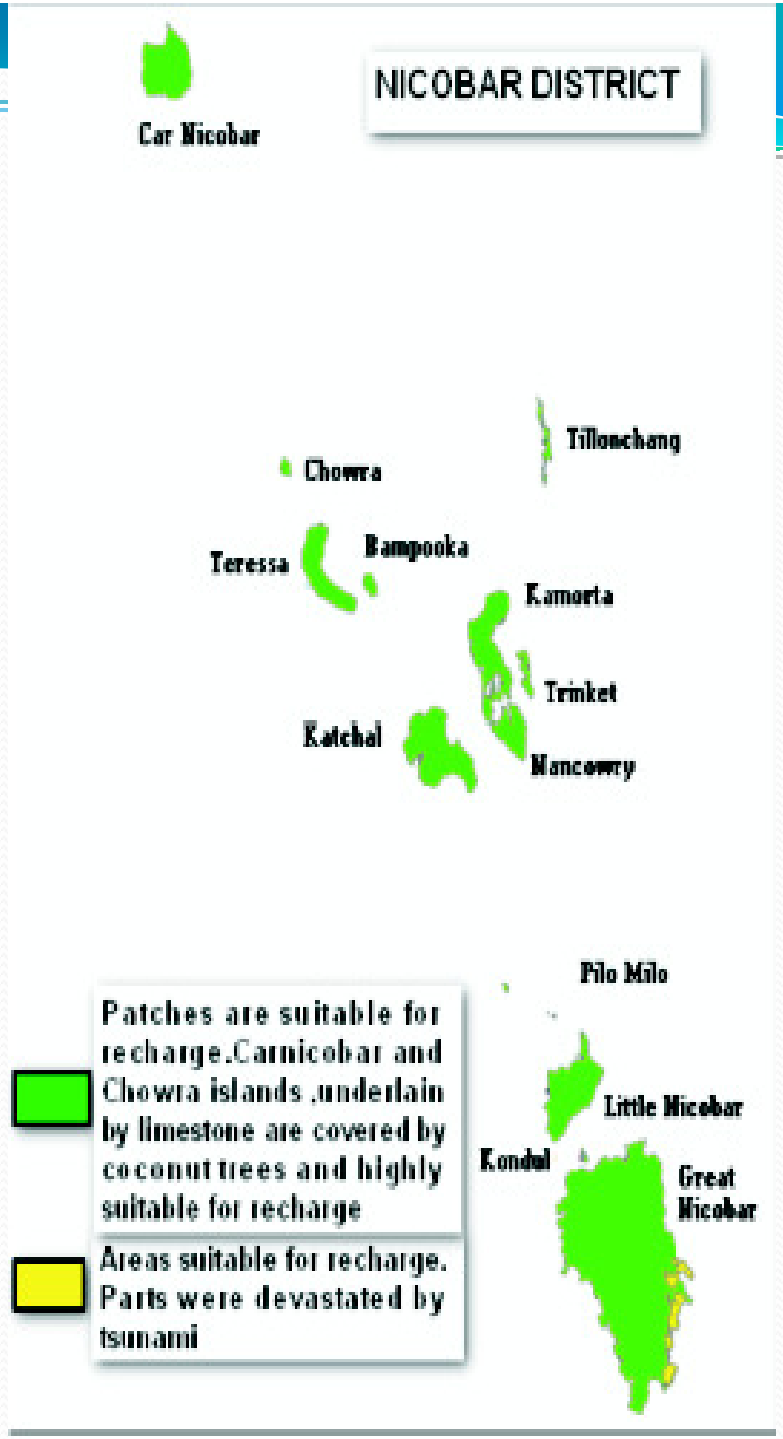
Areas identified for Artificial Recharge in Uttrakhand

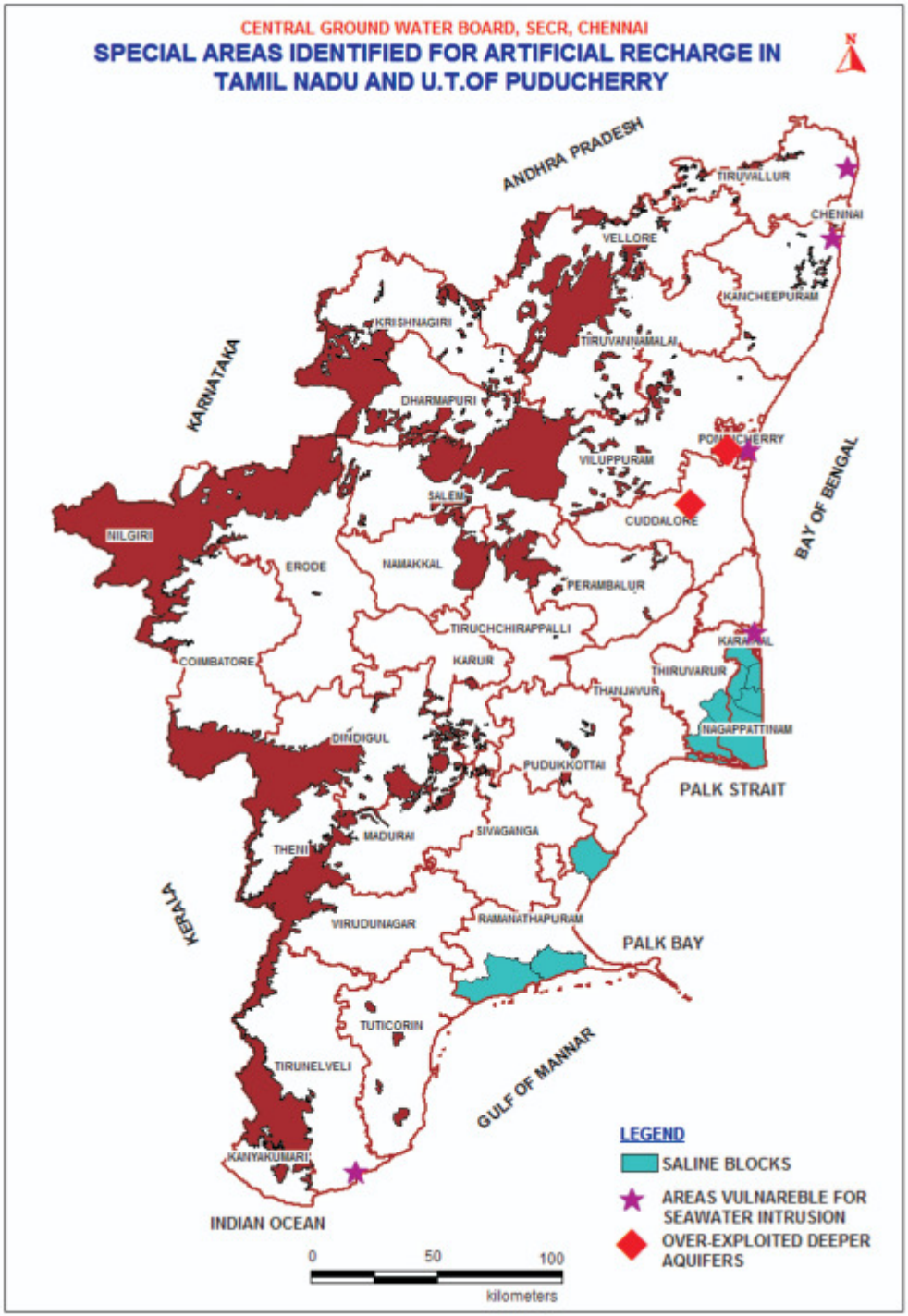


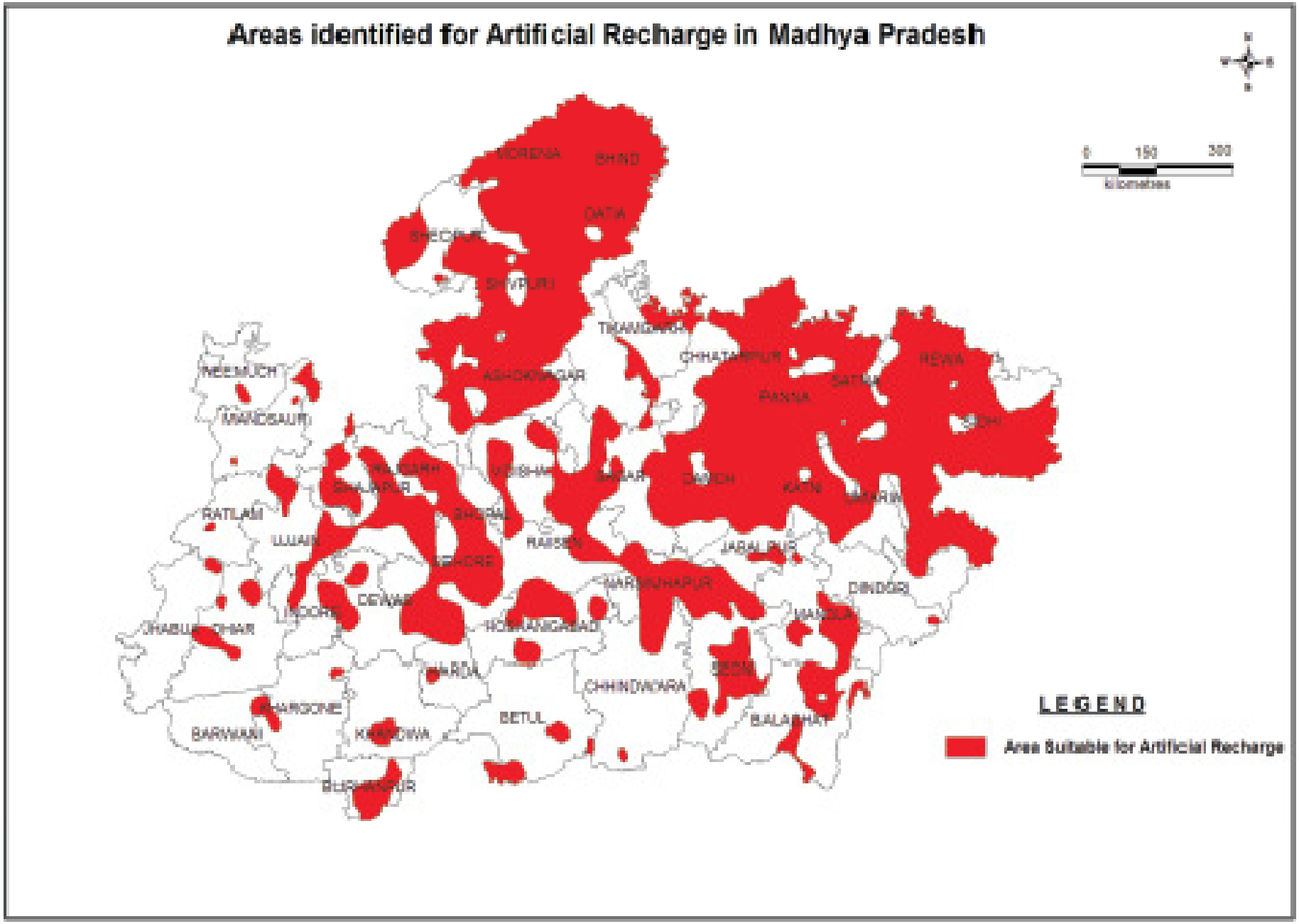
LEGEND

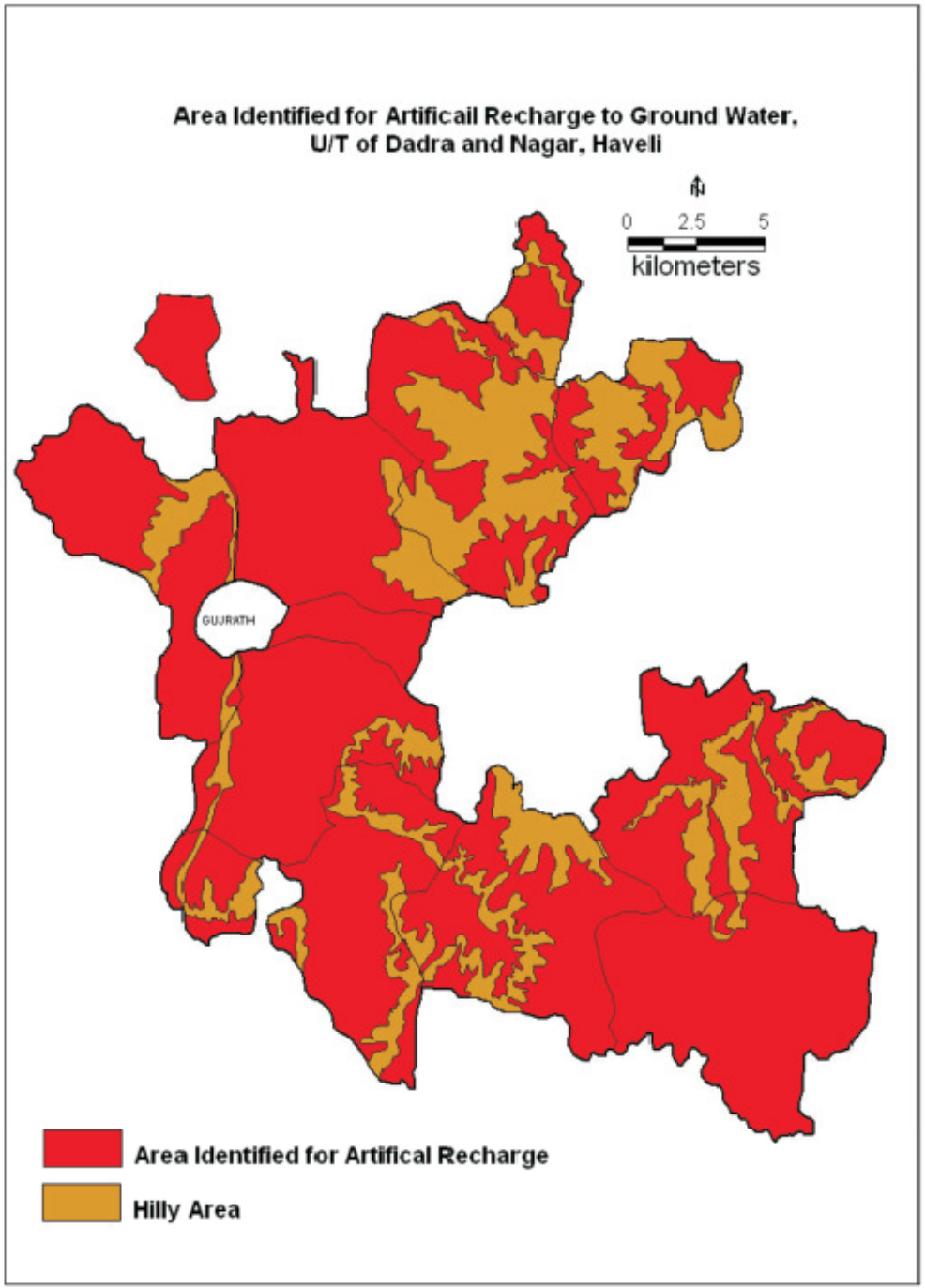
Area Suitable for Artificial Recharge

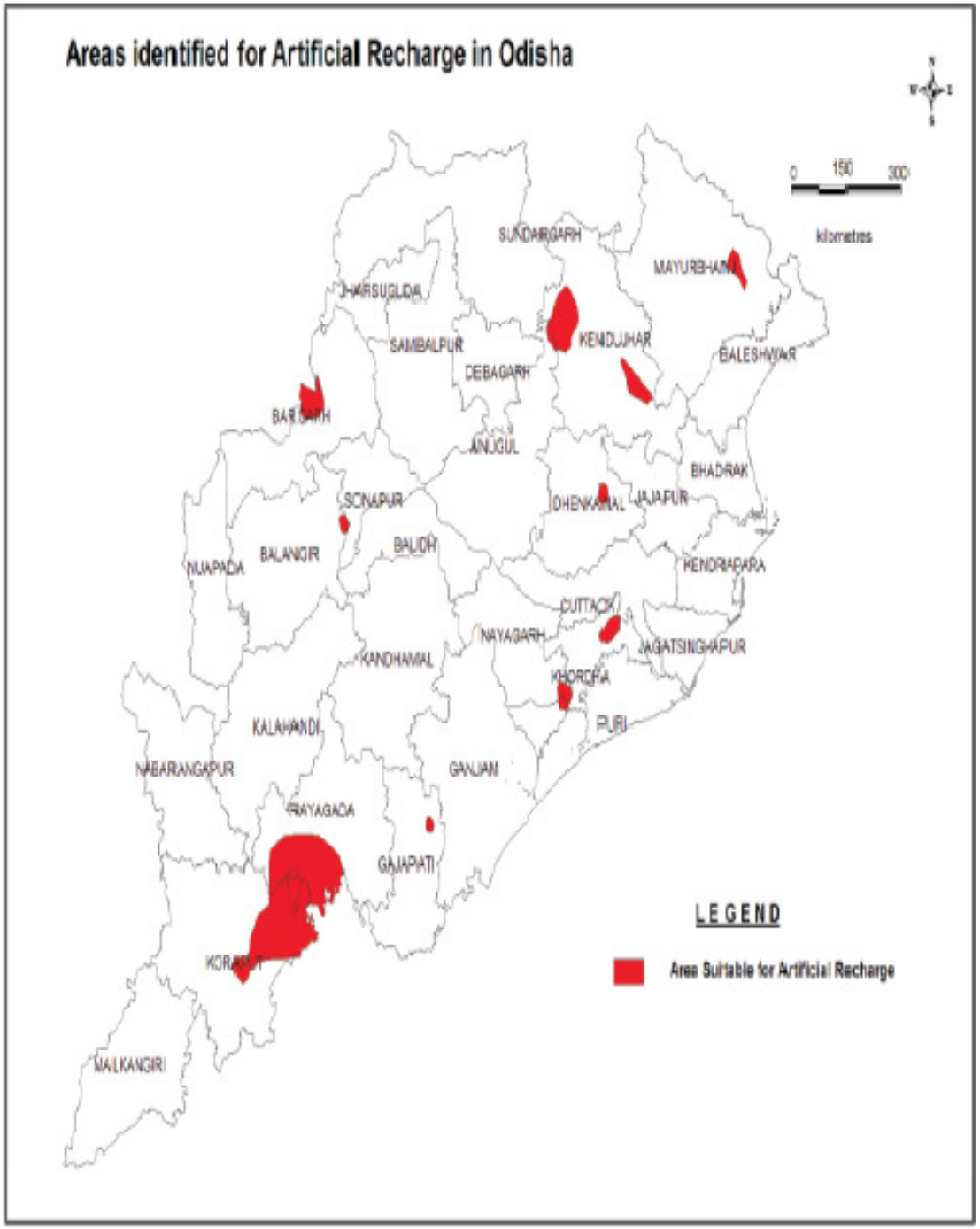

NORTH MIDDLE
ANDAMAN
DISTRICT
S.ANDAMAN
DISTRICT
Areas suitable
for Rechage


NICOBAR DISTRICT
Car Nicobar
Tillonchang
Chowra
Teressa
Bampooka
Kamorta
Trinket
Katchal
Nancowry
Pilo Milo
Little Nicobar
Kondul
Great Nicobar
Patches are suitable for recharge.Carnicobar and Chowra islands ,underlain by limestone are covered by coconut trees and highly suitable for recharge
Areas suitable for recharge. Parts were devastated by tsunami


CENTRAL GROUND WATER BOARD, SECR, CHENNAI
SPECIAL AREAS IDENTIFIED FOR ARTIFICIAL RECHARGE IN TAMIL NADU AND U.T.OF PUDUCHERRY
N
ANDHRA PRADESH
TIRUVALLUR
CHENNAI
VELLORE
KANCHEEPURAM
KRISHNAGIRI
TIRUVANNAMALAI
KARNATAKA
DHARMAPURI
VILUPPURAM
PONDICHERRY
BAY OF BENGAL
SALEM
CUDDALORE
NILGIRI
ERODE
NAMAKKAL
PERAMBALUR
TIRUCHCHIRAPPALLI
KARAIKAL
COIMBATORE
KARUR
THIRUVARUR
THANJAVUR
NAGAPPATTINAM
DINDIGUL
PUDUKKOTTAI
PALK STRAIT
MADURAI
SIVAGANGA
THENI
KERALA
VIRUDUNAGAR
RAMANATHAPURAM
PALK BAY
TUTICORIN
TIRUNELVELI
GULF OF MANNAR
KANYAKUMARI
INDIAN OCEAN
LEGEND
SALINE BLOCKS
AREAS VULNAREBLE FOR SEAWATER INTRUSION
OVER-EXPLOITED DEEPER AQUIFERS
0
50
100
kilometers


Areas identified for Artificial Recharge in Madhya Pradesh
0
150
300
Kilometres
MORENA
BHIND
DATIA
SHIVPURI
TIKAMGARH
CHHATARPUR
REWA
SATNA
PANNA
SIDHI
NEEMUCH
MANDSAUR
ASHOKNAGAR
RATLAM
UJJAIN
SEHORE
RAISEN
JABALPUR
KATNI
DINDORI
MANDLA
DEWAS
INDORE
HOSHANGABAD
HARDA
CHHINDWARA
SEONI
BALAGHAT
BETUL
KHANDWA
BARWANI
LEGEND
Area Suitable for Artificial Recharge


Area Identified for Artificail Recharge to Ground Water,
U/T of Dadra and Nagar, Haveli
N
0 2.5 5
kilometers
GUJRATH
Area Identified for Artifical Recharge
Hilly Area


Areas identified for Artificial Recharge in Odisha
0 150 300
kilometres
SUNDARGARH
MAYURBHANJ
JHARSUGUDA
KENDUJHAR
SAMBALPUR
BALESHWAR
DEBAGARH
BARGARH
ANUGUL
BHADRAK
SONAPUR
DHENKANAL
JAJAPUR
BALANGIR
BALUDH
NUAPADA
KENDRAPARA
CUTTACK
NAYAGARH
JAGATSINGHAPUR
KANDHAMAL
KHORDHA
PURI
KALAHANDI
NABARANGAPUR
GANJAM
RAYAGADA
GAJAPATI
KORAPUT
MALKANGIRI
LEGEND
Area Suitable for Artificial Recharge

MASTER PLAN FOR MAR IN INDIA

- Area identified for MAR = 941541 km^2
- Volume to be recharged = 85565 MCM
- No. of structures proposed = 110.82 Lkh

  (Rural = 22.83 Lkh.; Urban = 87.99 Lkh.)
- Estimated Cost = 79178 Crores

  (Rural = 61192 Cr.; Urban = 17986 Cr.)

MOST RECHARGE STRUCTURES

Type of Structures	No. of Structures	Total Cost (Rs.)
Check Dam	2,90,577	13457.09
Gabion	1,55,394	407.22
Gully Plug	6,26,229	1282.40
Injection Well	16,235	449.16
Nala Bund	4,09,446	11113.28
Percolation Tank	84,925	17225.42
Recharge Shaft	5,90,714	15541.43
Subsurface Dyke	8281	329.46
Spring Development	2950	186.50
Contour Bund	1,08,438	2236.70
Roof Top Rainwater Harvesting	87,66,594	16266.14
Others	23,172	683.00
Total	**1,10,82,955**	**79177.80**

ROAD MAP OF IMPLEMENTATION

- Watershed Development.
- Bharat Nirman.
- Irrigated Agriculture Modernization, Water Bodies Restoration and Management Project (IAMWARM).
- Drought Prone Area Programme (DPAP).
- National Watershed Development Programme for Rainfed Areas (NWDPRA).
- NABARD assisted Rainwater Harvesting Programme for augmentation of ground water recharge.

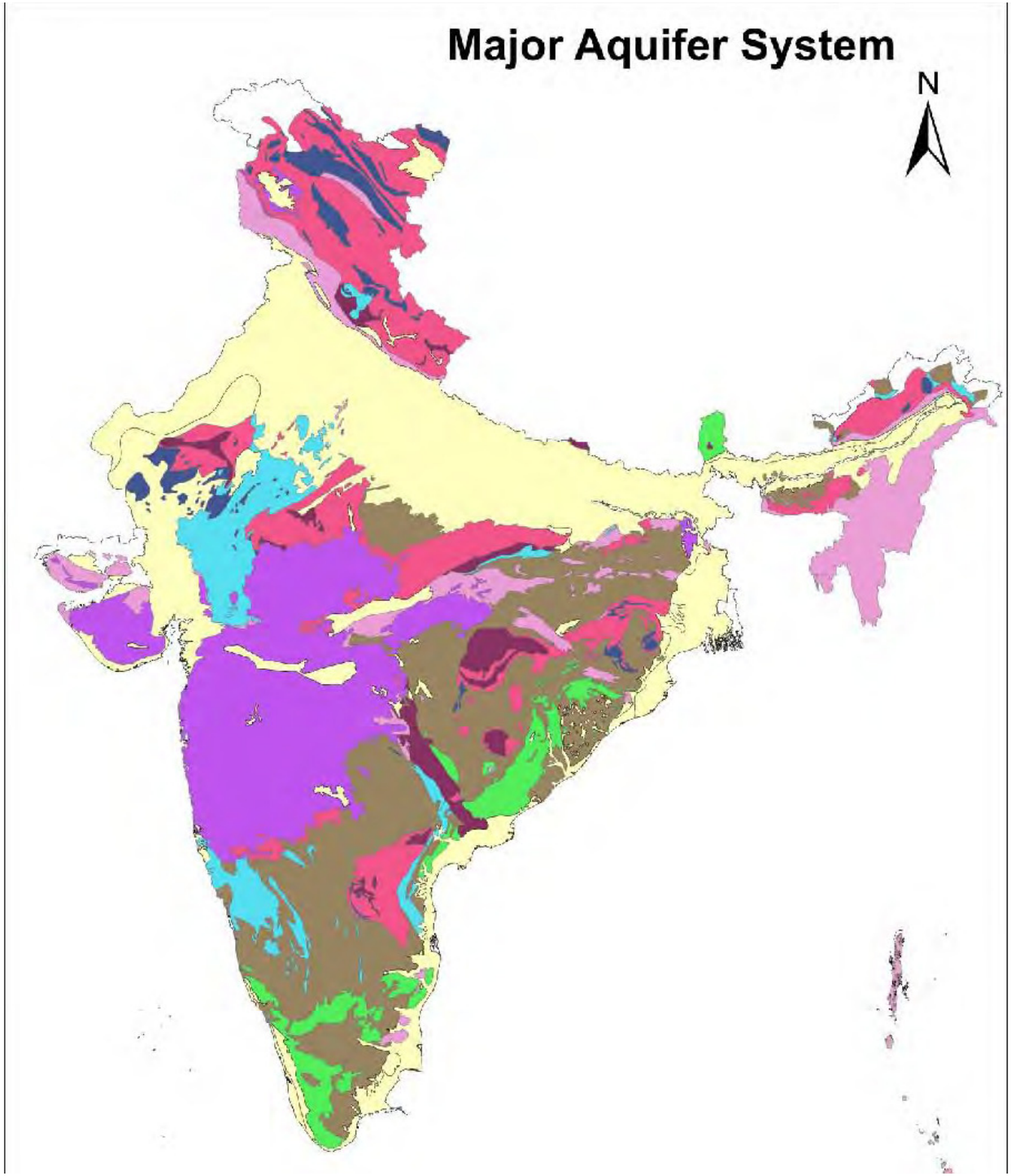
ROAD MAP OF IMPLEMENTATION

- Rehabilitation of Tanks identified by MLAs.
- Command Area Development & Water Management Programme.
- Mahatma Gandhi National Rural Employment Guarantee Programme (MGNREGA).
- Water conservation in reserved forest area.
- Dugwell Recharge Programme by NABARD and State agencies in seven States.
- Local Area Development Programme of MPs and MLAs.

GOVERNING FACTORS

- Local situation.
- Type of aquifer.
- Topography.
- Land use.
- Intended uses of the recovered water.

Major Aquifer System



Age	Formation	Lithology	Color Code
Quarternary	Unconsolidated	Recent & old alluvial and aeolian (clay, silt, sand, pebble, gravel), Calcareous older alluvium (clay, silt, sand,pebble, gravel), laterite, lithomargic clay, ferruginus concretions	
Cenozoic, Mesozoic	Consolidated Effusive	Basalt with/without intertrppeans	
Cenozoic, Mesozoic, Upper Palazoic	Semi-Consolidated	Sandstone, shale, limestone & conglomerates	
Cenozoic, Proterozoic	Consolidated Intrusive	Granite, Ultramafics & Dolerite	
Cenozoic, Proterozoic	Sedimentary and Meta sedimentary	Shale. Quartzite. Slate. Sandstone. Phvllite. Schist	
Proterozoic	Sedimentary and Meta sedimentary	Limestone & Dolomite	
Proterozoic, Azoic	Meta Sedimentary	Schist, Phyllite, Slate, Gneiss, Marble	
Proterozoic, Azoic		Charnockite, Khondalite	
Azoic	Basal Crystalline	Granite-Gneiss Complex	

ROCK TYPES IN INDIA

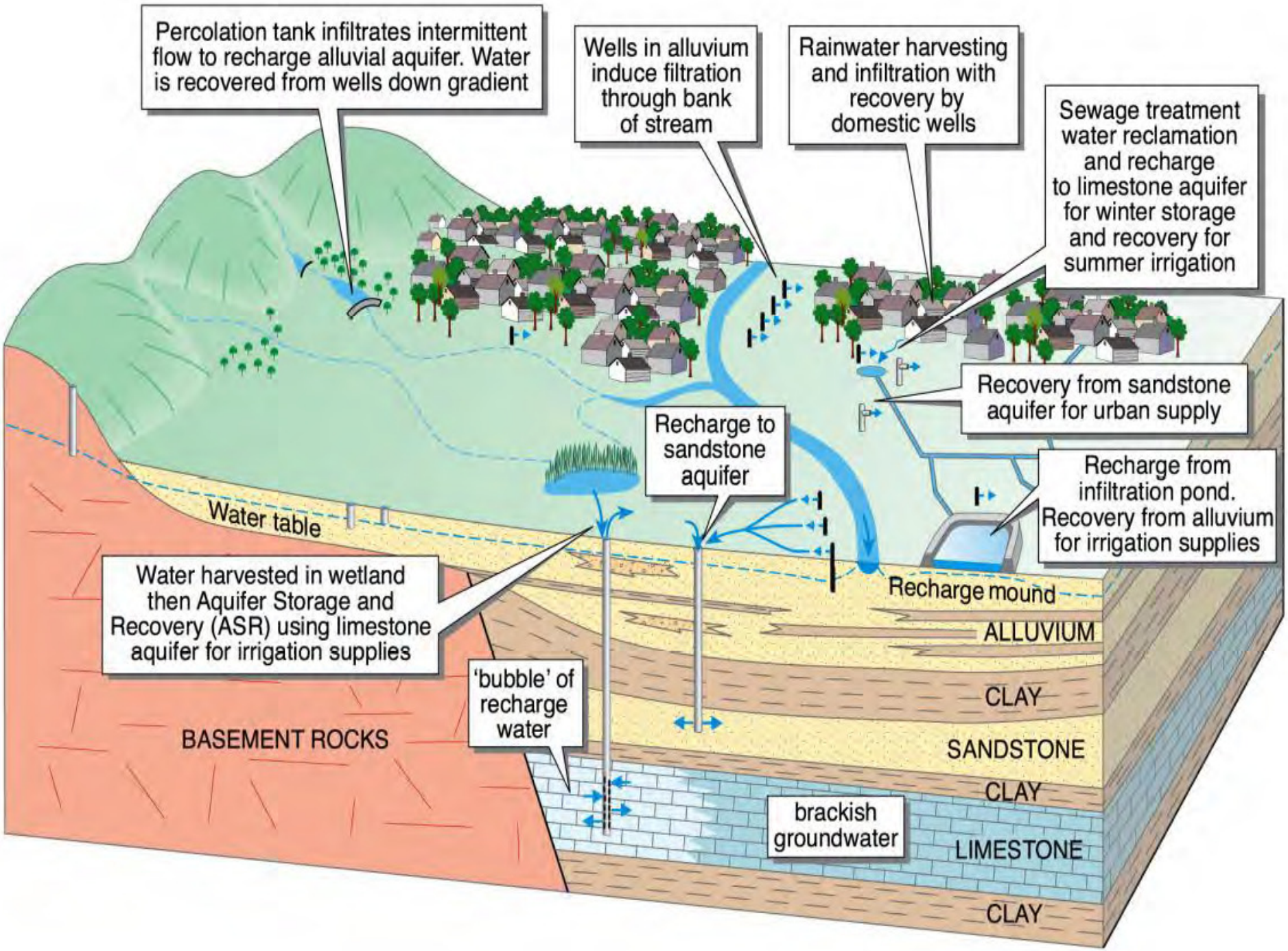
- 1. Porous rock formation
  - Unconsolidated formations.
  - Semi-consolidated formations
- 2. Hard rock/ consolidated formations
  - Igneous and metamorphic rocks (excluding volcanic and carbonate rocks)
  - Volcanic rocks
  - Carbonate rocks

Activity under XII Five Year Plan

Paradigm shift from
"Ground Water Development"
to
"Ground Water Management".
through
NATIONAL AQUIFER MAPPING
(NAQUIM)

NATIONAL AQUIFER MAPPING PPROGRAMME (NAQUIM)

Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical field and laboratory analyses are applied to characterize the quantity, quality and sustainability of ground water in aquifers.


Percolation tank infiltrates intermittent flow to recharge alluvial aquifer. Water is recovered from wells down gradient
Wells in alluvium induce filtration through bank of stream
Rainwater harvesting and infiltration with recovery by domestic wells
Sewage treatment water reclamation and recharge to limestone aquifer for winter storage and recovery for summer irrigation
Recovery from sandstone aquifer for urban supply
Recharge to sandstone aquifer
Recharge from infiltration pond. Recovery from alluvium for irrigation supplies
Water table
Water harvested in wetland then Aquifer Storage and Recovery (ASR) using limestone aquifer for irrigation supplies
Recharge mound
ALLUVIUM
CLAY
'bubble' of recharge water
BASEMENT ROCKS
SANDSTONE
CLAY
brackish groundwater
LIMESTONE
CLAY

MAR TECHNIQUES

- **Direct Methods**
- **Indirect Methods**
- **Combination Methods**

MAR TECHNIQUES: **Direct Methods**

- Surface Spreading Techniques
  - Flooding
  - Ditch and Furrows
  - Recharge Basins
  - Runoff Conservation Structures
    - Bench Terracing
    - Contour Bunds and Contour Trenches
    - Gully Plugs, *Nalah* Bunds, Check Dams
    - Percolation Tanks/Ponds
  - Stream Modification / Augmentation

MAR TECHNIQUES: **Direct Methods**

- Sub-surface Techniques
  - Injection Wells (Recharge Wells)
  - Gravity Head Recharge Wells
  - Recharge Pits and Shafts

MAR TECHNIQUES: **Indirect Methods**

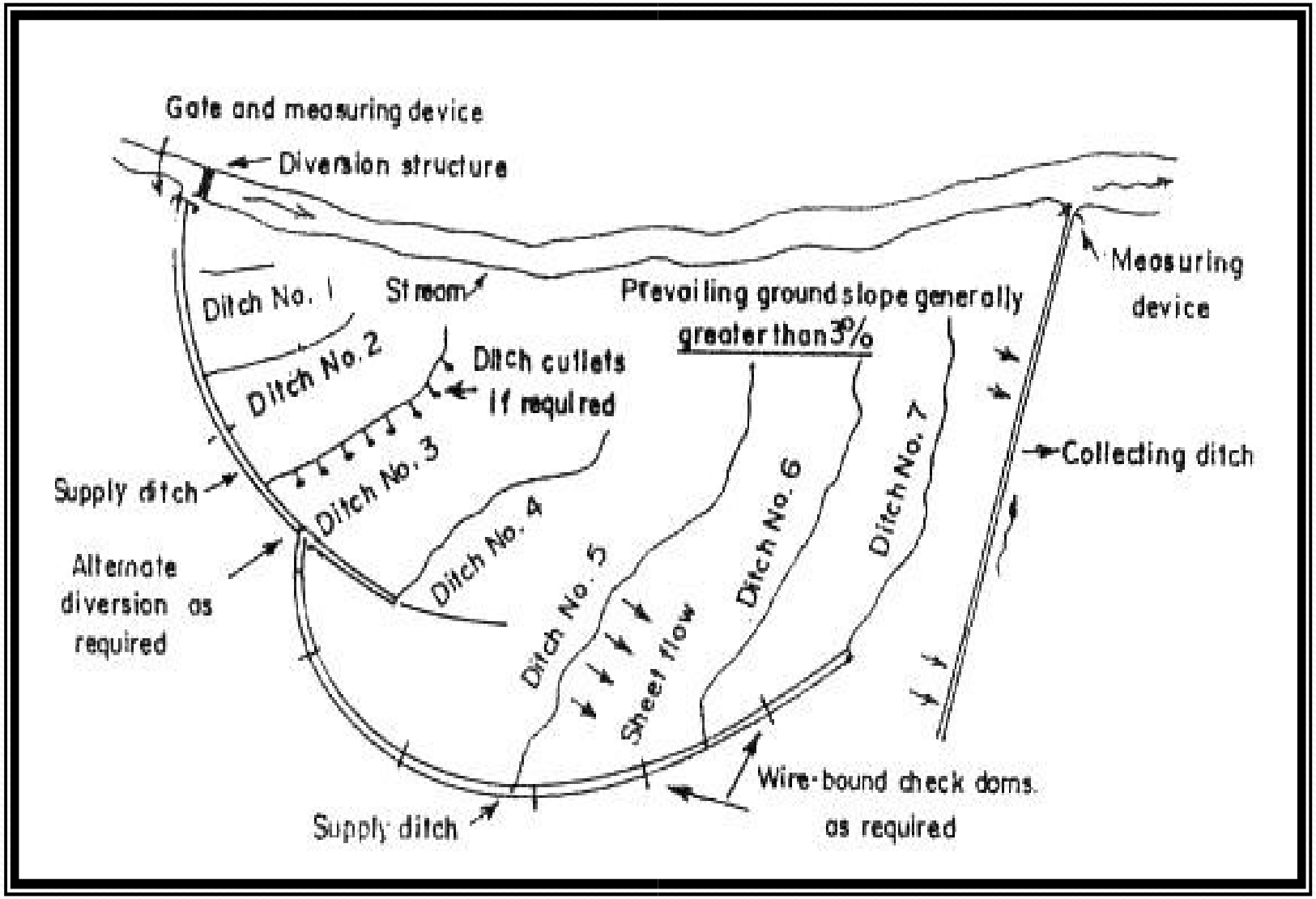
- Induced Recharge from Surface Water Sources
- Aquifer Modification
  - Bore Blasting.
  - Hydro-fracturing.

MAR TECHNIQUES:
Combination Methods

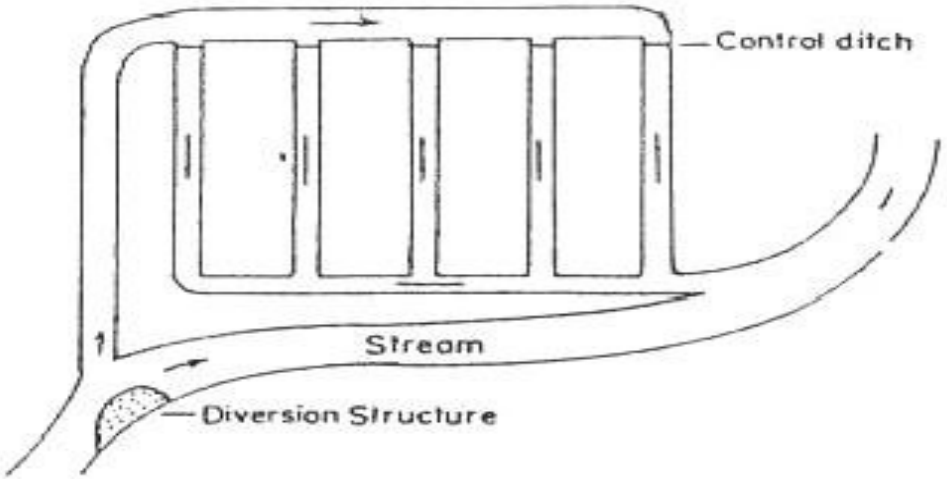
- Sub-surface dykes (Underground *Bandharas*)
- Fracture Sealing Cementation Techniques

Surface Spreading Techniques: FLOODING

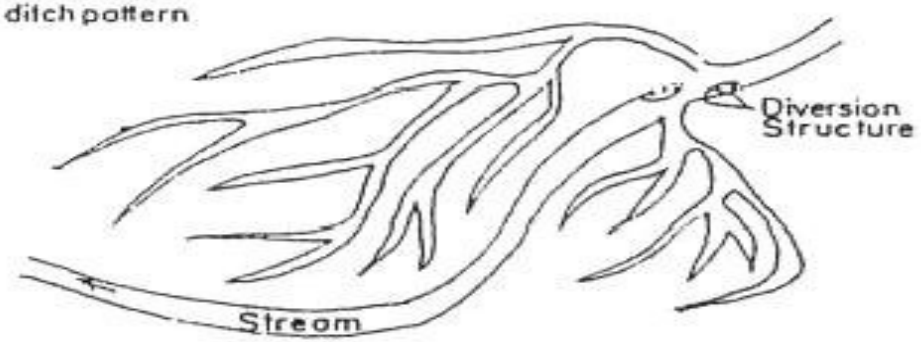
Surface Spreading Techniques:
DITCH & FURROW METHOD



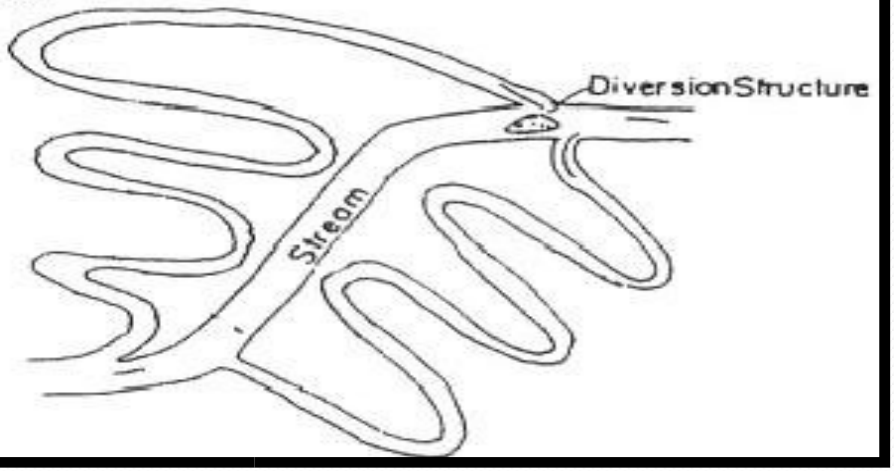
A Lateral ditch pattern



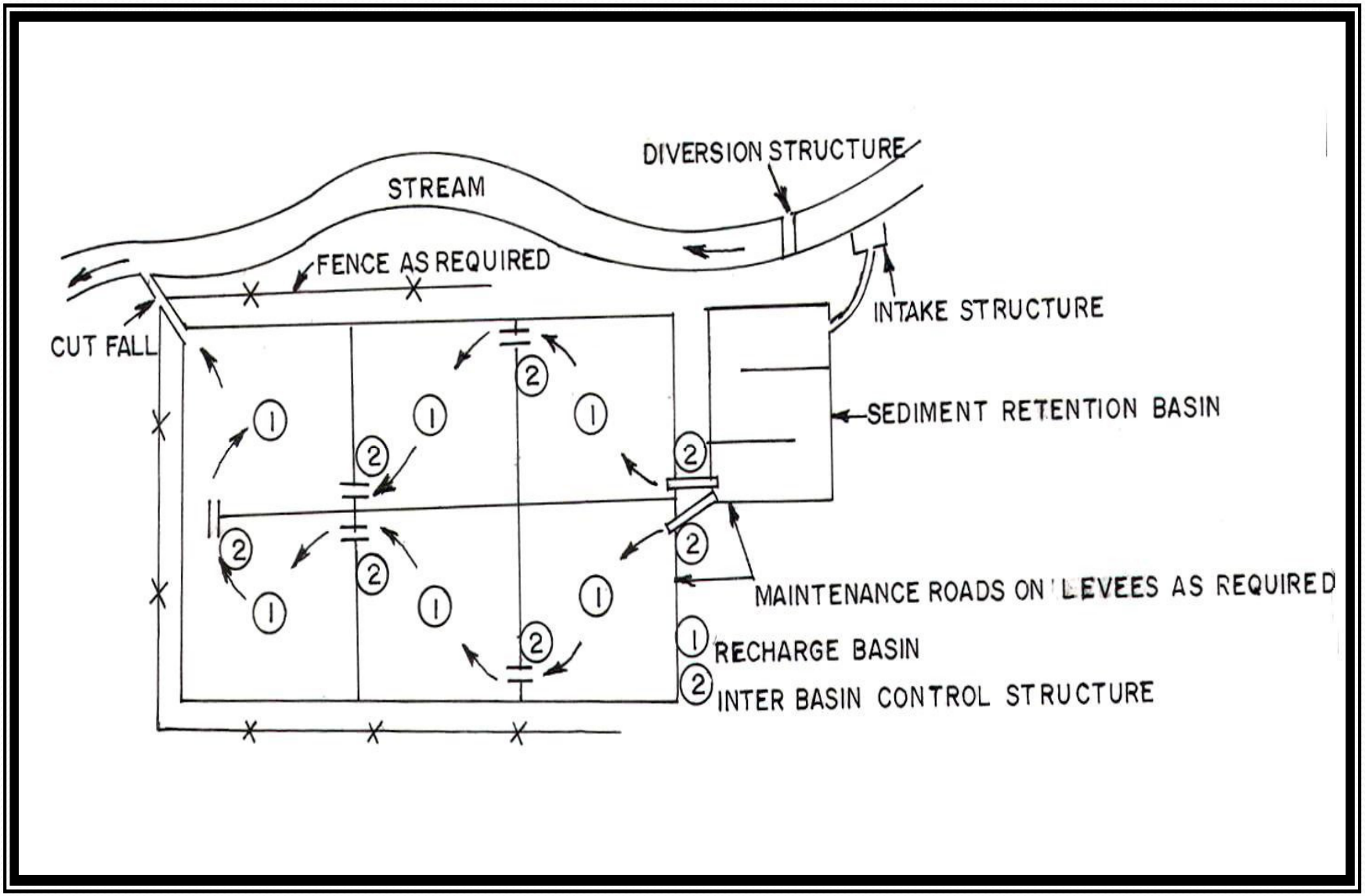
B Dendritic ditch pattern



C Contour ditch pattern



Surface Spreading Techniques: RECHARGE BASINS



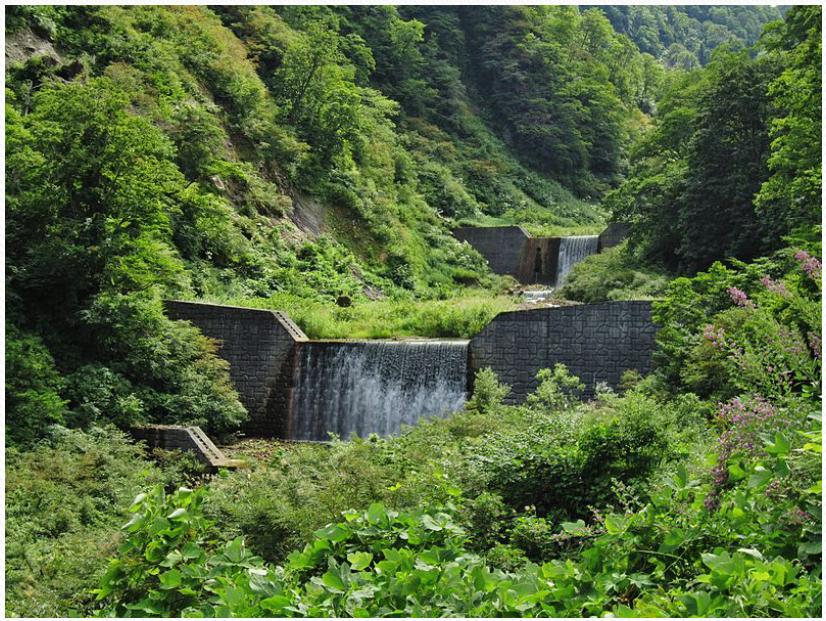
Runoff Conservation Structures:

BENCH TERRACING

Runoff Conservation Structures: CHECK DAM

Kudumboor across the Chandragiri River

Runoff Conservation Structures: CHECK DAM



Concrete check dams

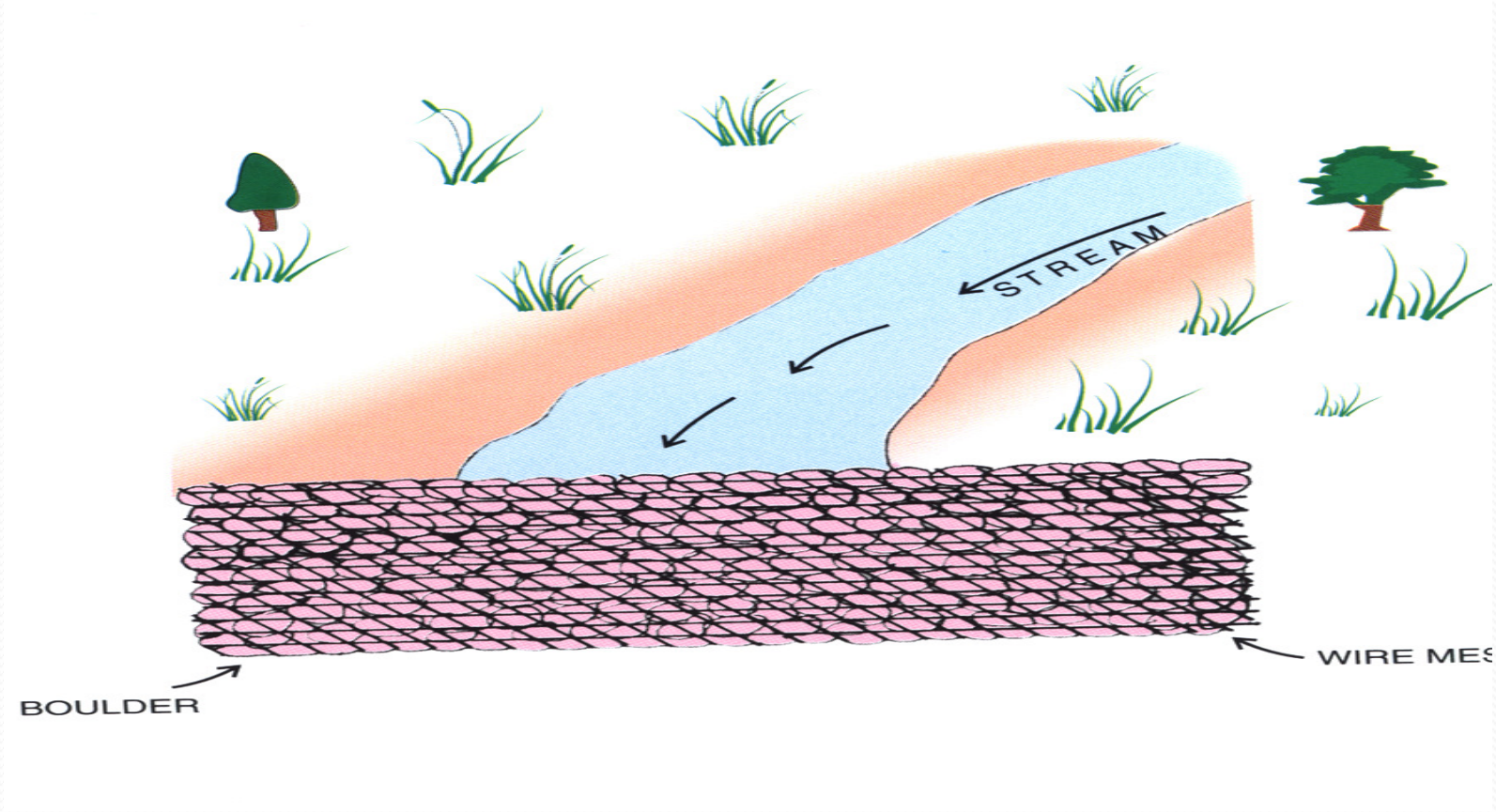
A steel check dam

Runoff Conservation Structures:
CHECK DAM, GULLY PLUG, *NALAH* BUND

Runoff Conservation Structures: A CEMENT PLUG

Runoff Conservation Structures: NALA BUND

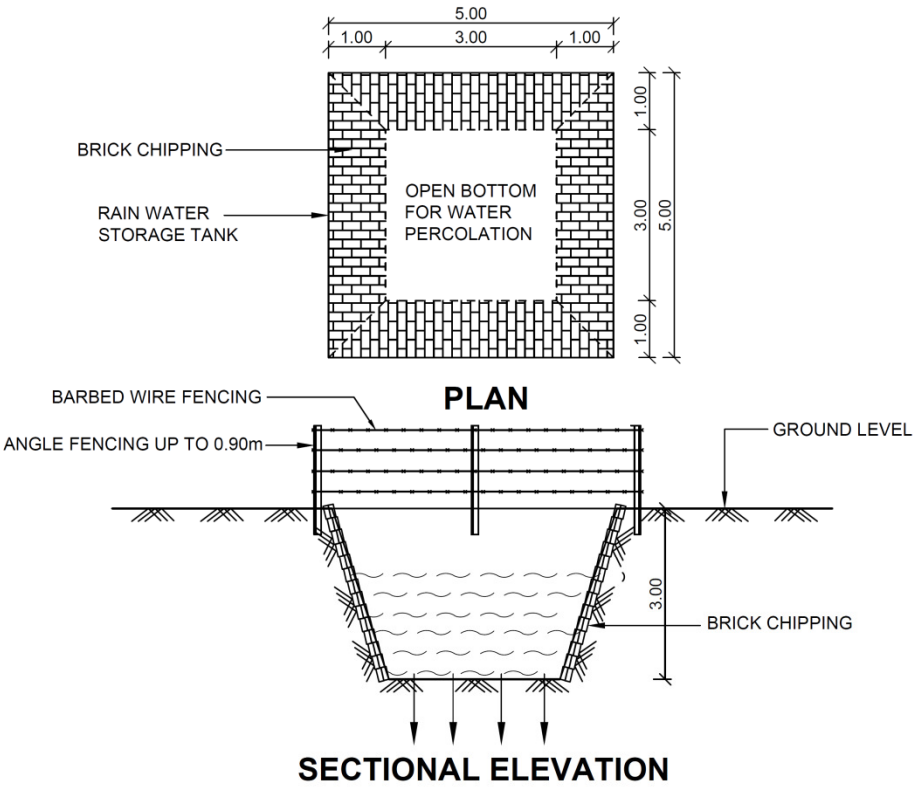
Runoff Conservation Structures: A GABION

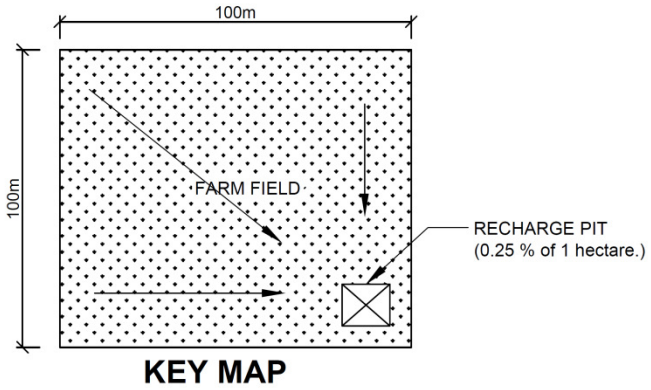


Runoff Conservation Structures:

PERCOLATION TANK

TYPICAL DESIGN FOR RECHARGE PIT IN FARM





CONCLUSIONS

- India's water situation is in precarious state, and needs immediate attention.
- The country offers enormous scope for managed aquifer recharge.
- It has varied hydrogeological set-up, and choice of any recharge structure depends on local situation.

"Don't let the water run in the sink, our life is on the brink"